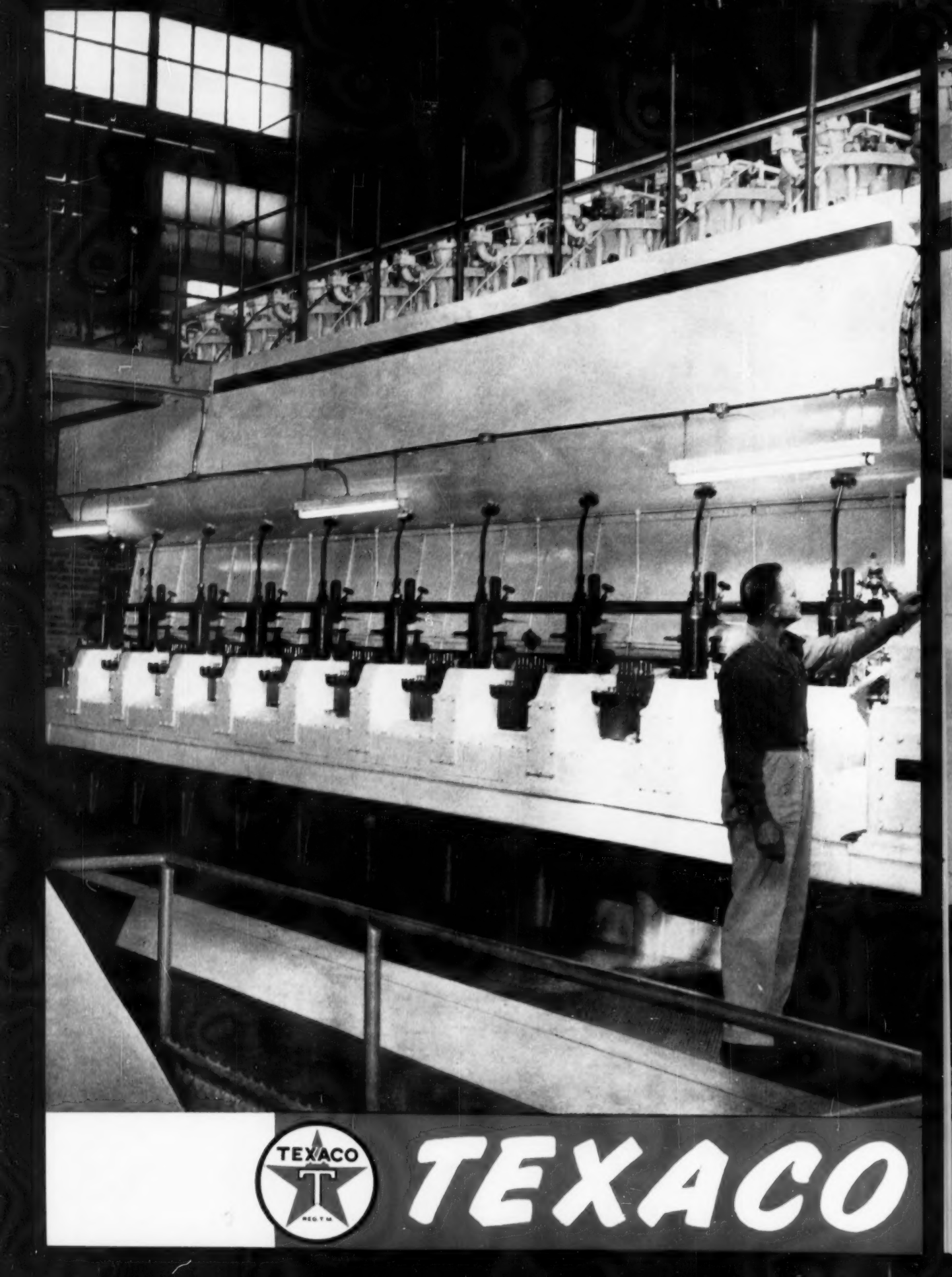
diesel power

September, 1955

Lab tests as a maintenance tool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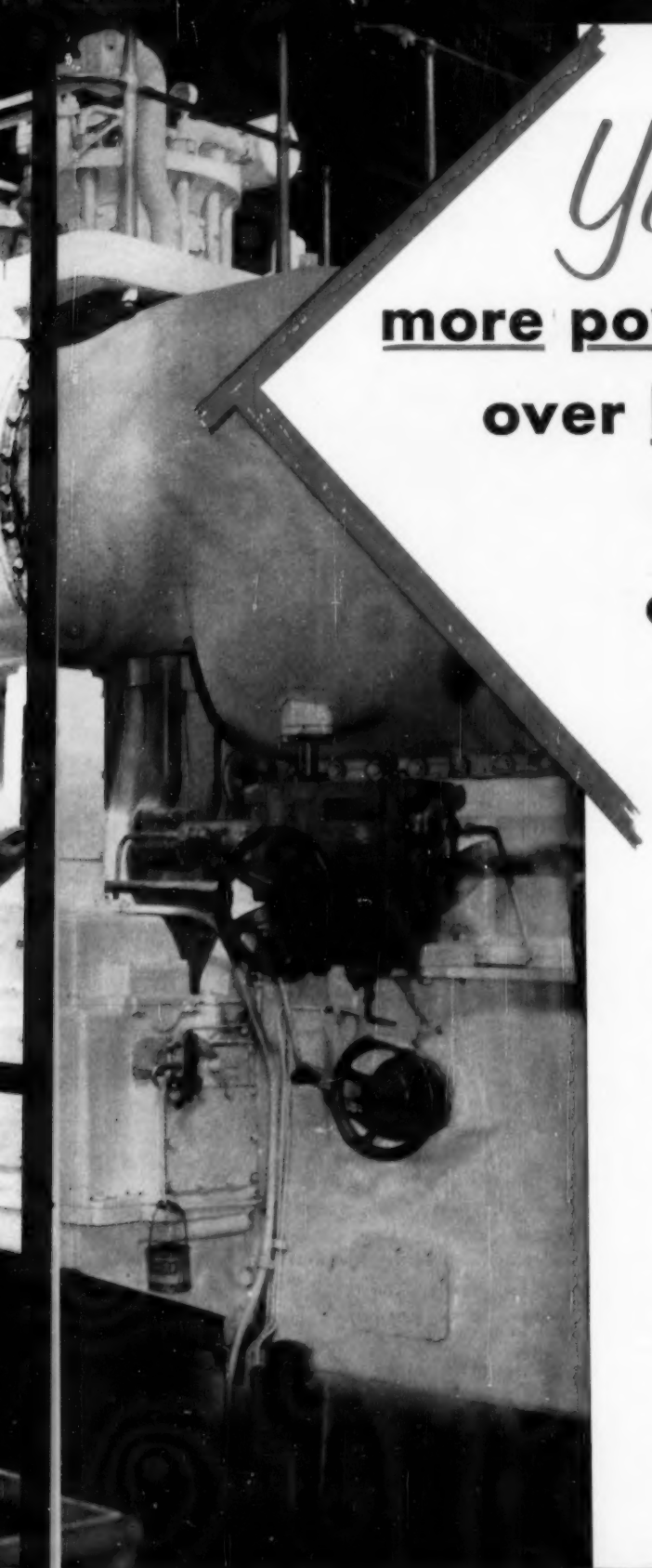

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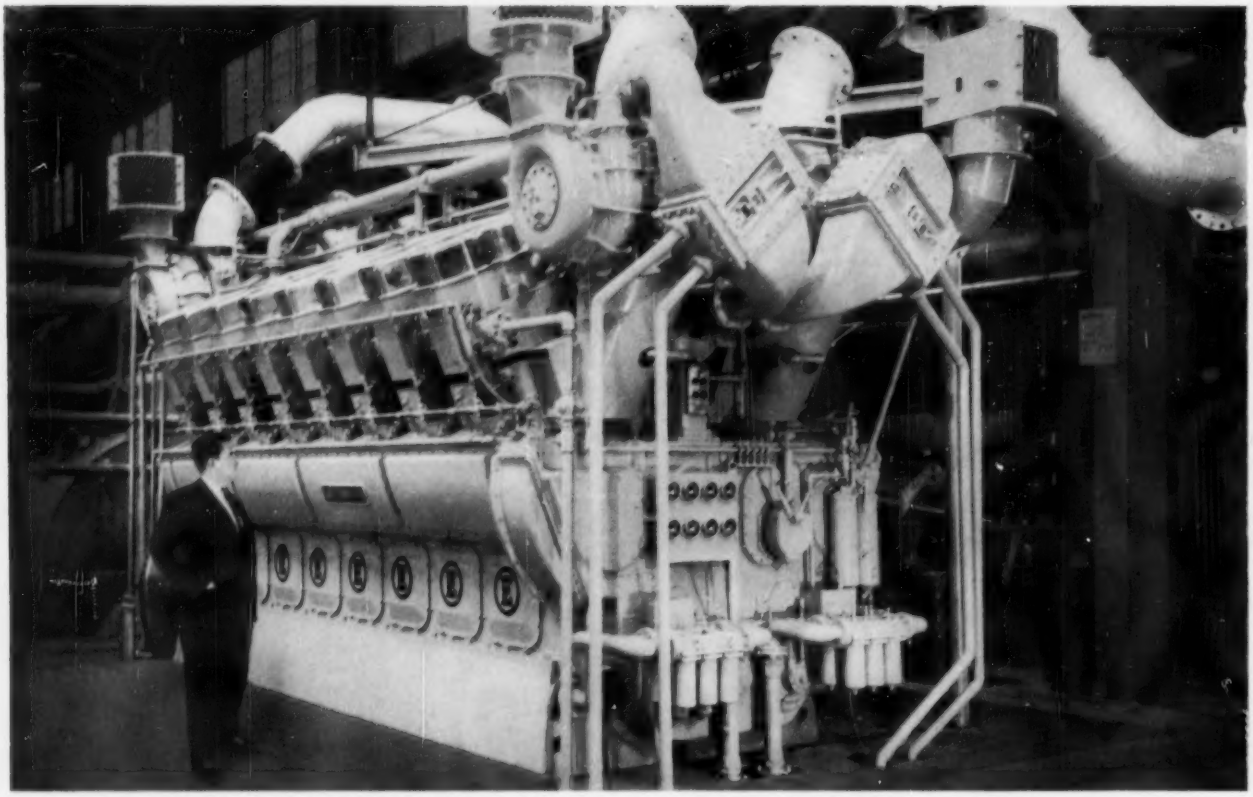

New 7,700 HP Enterprise RV is 20% shorter, 30% less weight than conventional 16-cylinder diesels of equal power.

Enterprise announces the new 16-cylinder RV diesel —World's smallest 7,700 HP engine

"It is a pleasure to present this Enterprise engine—the newest in our line of dependable diesels. The many features and economies of the Enterprise RV make it extremely attractive to users of high horsepower engines—both marine and stationary."

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Here at last is a turbocharged V-type, heavy-duty engine specifically developed to produce *more* horsepower in a *smaller* unit —dependably and continuously.

For marine installations this means more payload space, greater tonnage capacity than ever before. For electric power generation in municipal or industrial plants, and as power for pumping oil, gas or water, the reduced costs of foundations, installation, operation and maintenance make the RV even more attractive to engineers and owners.

Diesel, dual fuel, tri-fuel, spark ignition

The RV can be operated as a diesel, dual fuel, tri-fuel, or spark ignited gas engine. Its low operating costs on diesel fuel can be cut even further when residual fuels are used. This is "workhorse" power at its dependable best. Thousands of continuous, uninterrupted hours without shutdown are characteristic of the RV's slow-speed operation.

Less bulk makes installation easier, servicing simpler. RV maintenance doesn't require major disassembly, either. All working parts are accessible for service from the outside. So overhaul costs are kept low and downtime is reduced to an insignificant factor.

Vital statistics of Enterprise RV:

Type: 4-cycle, 12 or 16 cylinders, 17" bore by 21" stroke

Rating: To 7,700 BHP at 400 rpm. Piston speed: 700-1,400 fpm.

Dimensions: 26'4" long, 9'4" wide, 12'1" high

Weight: (less flywheel) 189,100 lb.

Fuel: Diesel, dual fuel, tri-fuel, spark ignited gas

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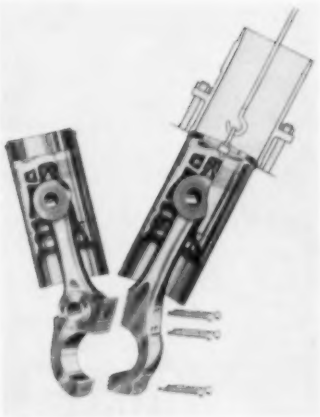
How the exclusive Enterprise turbocharged V-block design packs more heavy-duty horsepower into less space, less weight

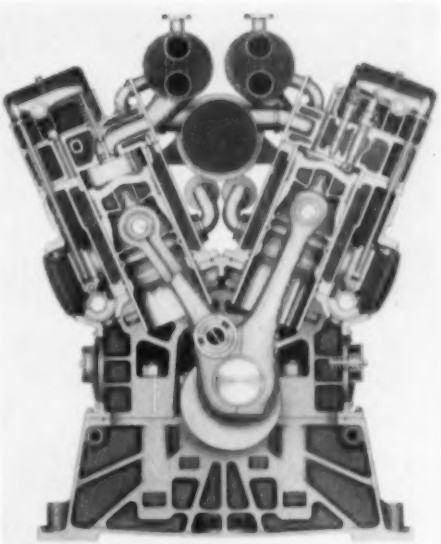


Connecting rod design cuts engine length 20%

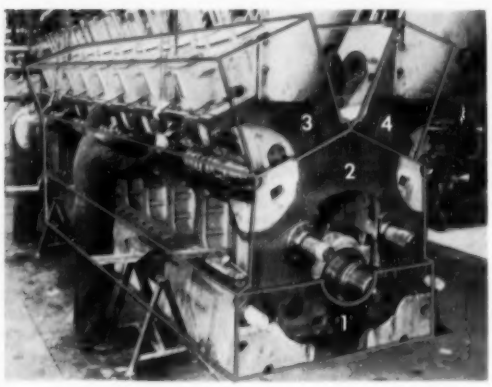
The master-and-link articulated connecting rod permits opposite cylinders in the V to lie in the same plane. Weight-to-horsepower ratio is reduced to only 25 lb. per HP — some 30% less than conventional units.

Completely accessible — easy to service

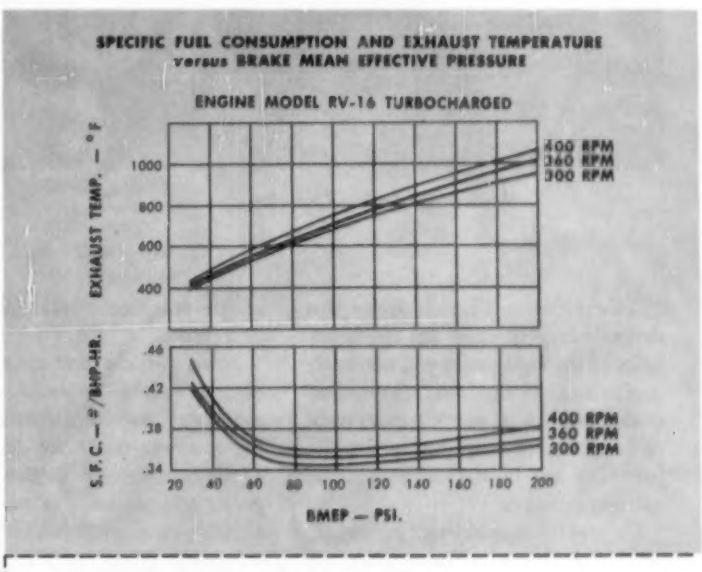
The master connecting rod features a rack-tooth joint for quick and easy removal of the entire assembly. Simply release six clamping bolts and withdraw con rod and piston through cylinder liner.



For practicality in manufacture, shipment, installation and maintenance, the RV engine frame is built in four pieces — base (1), crankcase (2) and two identical cylinder blocks (3 & 4), all of quality-controlled cast iron for maximum strength and rigidity.



The high performance standards achieved by the Enterprise RV-16 turbocharged engine are shown on the curve at right. Tests are made under standard conditions on the 10,000 HP capacity hydraulic dynamometer specially built for this new high-horsepower engine series.



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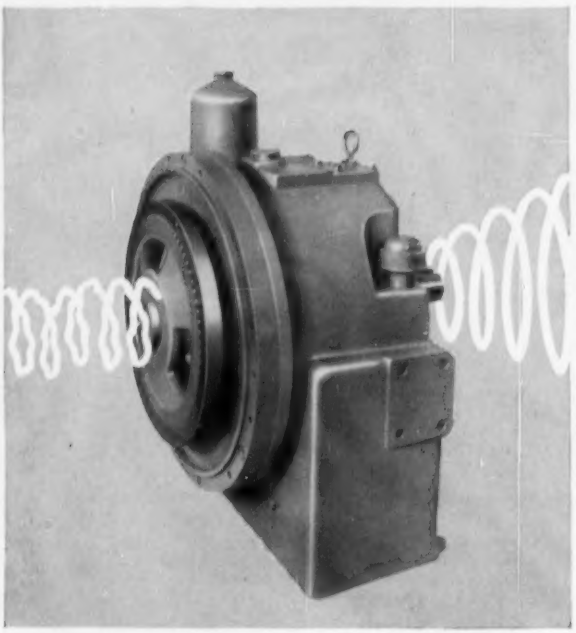
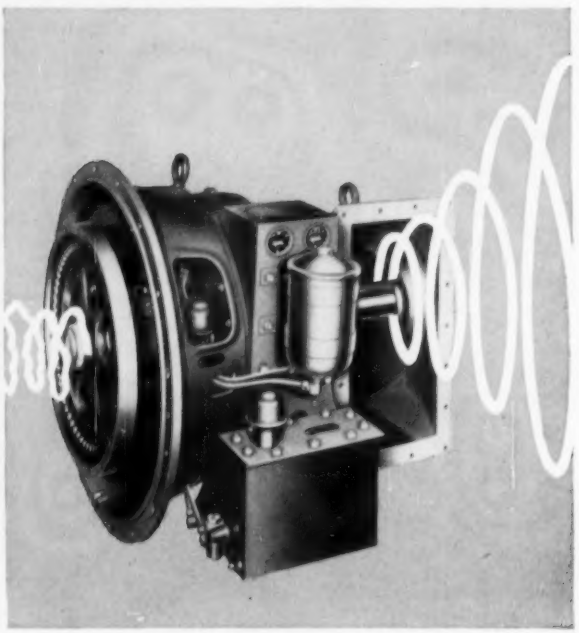
Single-Stage or Three-Stage Torque Converters?



Single-Stage Torque Converter



Three-Stage Torque Converter

The answer to this question depends largely upon the characteristics of the equipment you manufacture *or* use and the jobs it is required to do. Naturally, many factors must be known before any engineering department can be expected to make recommendations.

Generally speaking, however, when it is desired to have minimum pulldown from governed engine speed—with maximum power output over a wide range—and to produce high torque ratios for hoisting or heavily loaded vehicles, a three-stage torque converter, with torque multiplication up to *six times,* may be most desirable. On the other hand, where mild torque conversion is required, as in certain types of vehicles and in other industrial equipment — a single-stage converter may be the best choice.

Now, for the first time, you can benefit from the *unbiased recommendations* of one manufacturer in choosing a torque converter—*single-stage or three-stage* — with the exact capacity and torque transmission characteristics to give your equipment *maximum efficiency.*

The Twin Disc Clutch Company's new line of single-stage torque converters—now available in the 1500 Series—complements its time-tested, universally accepted line of three-stage units. Single-stage *or* three-stage—from 30 to 1000 hp—you can depend on Twin Disc Torque Converters to give your equipment better performance . . . less downtime . . . and greater earning potential.

In addition to offering *the most complete — the most versatile* line of industrial torque converters available, Twin Disc manufactures fluid couplings in a wide range of sizes for engines and motors from ¾ to 850 hp, and friction clutches for applications from fractional to 1050 hp.

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Publisher
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Subscription Rates

	Single Copies	1 year	2 years	3 years
U. S.	35¢	$4.00	$7.00	$ 9.00
Canada	35¢	4.00	7.00	9.00
Foreign	75¢	8.00	13.00	17.00

Diesel Power is indexed regularly by Engineering Index, Inc. and is available in microfilm editions from University Microfilms, Inc., Ann Arbor, Michigan.

DIESEL POWER for September, 1956. Vol. XXXIV, No. 9. It is published monthly by **DIESEL PUBLICATIONS, INC.**, Executive and Editorial Offices at **80 LINCOLN AVE., STAMFORD, CONN.** Tel. DAvis 4-2131. Entered as second class matter at the Post Office, Kutztown, Pa., under Act of March 3, 1879. Copyright 1956, Diesel Publications, Inc.

diesel power

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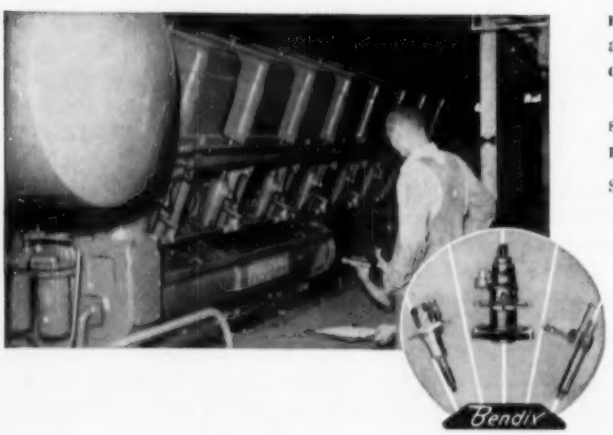

When the sixteen-year-old dredge "Port Arthur" was modernized with the installation of a new 2800-h.p. Nordberg Supairthermal® V type Diesel with Bendix* fuel injection equipment, a number of very amazing results occurred.

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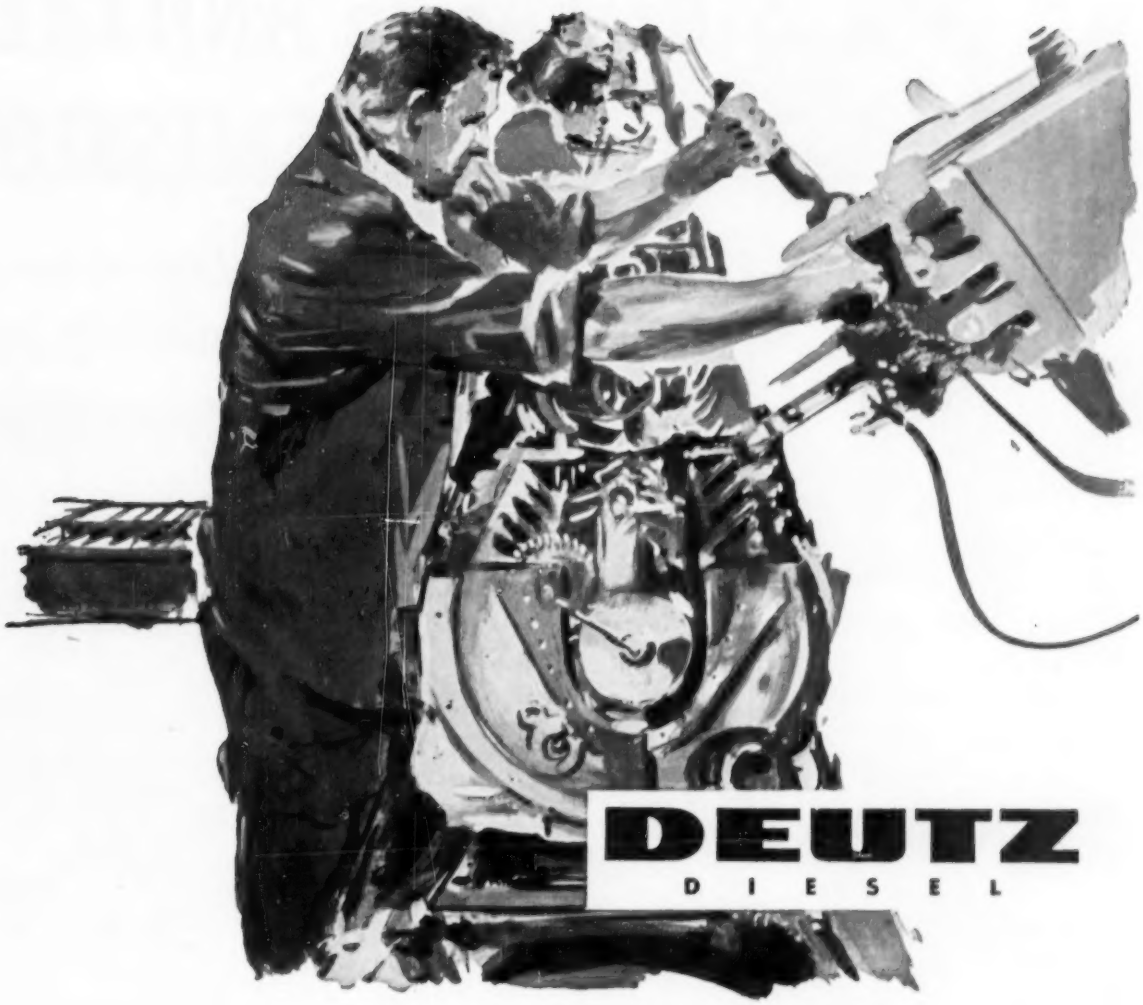

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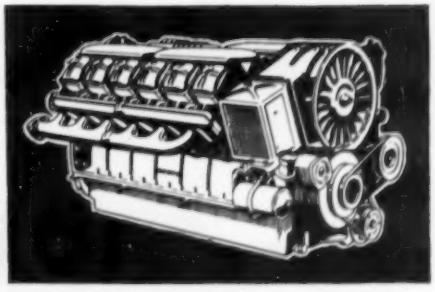

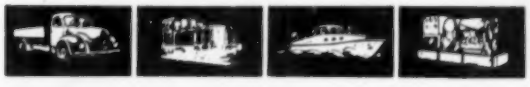

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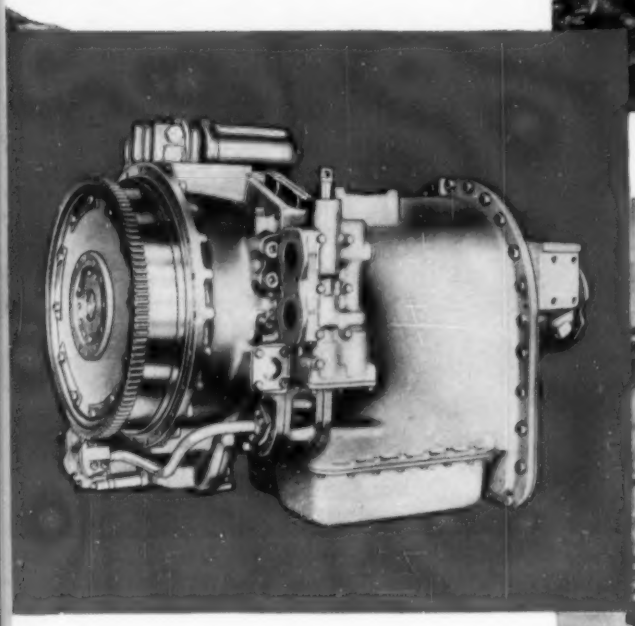

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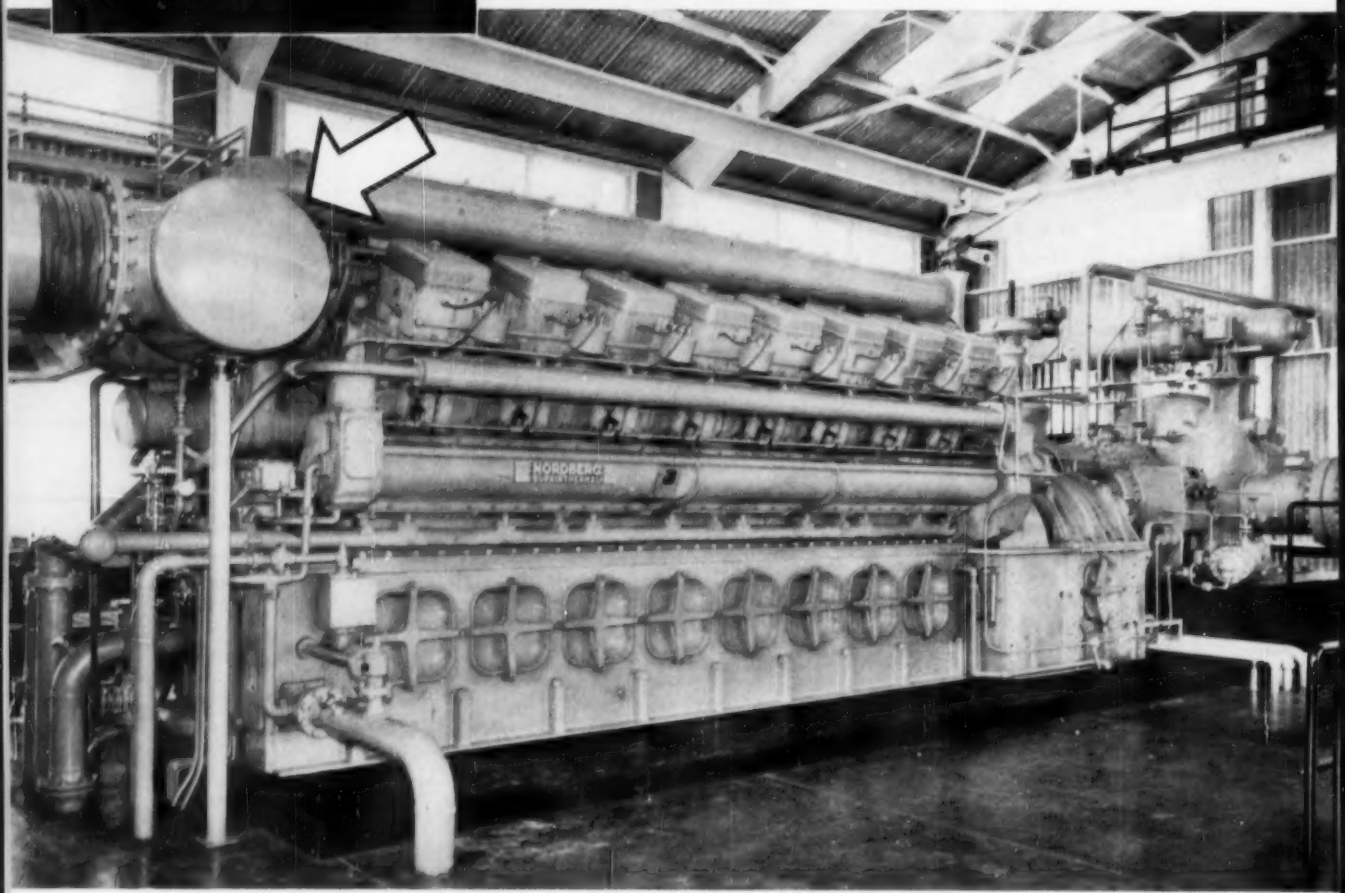

A Nordberg Supairthermal 3550 hp, 16-cylinder gas engine is turbocharged by a De Laval B-13 high pressure unit. This gas engine-gear set is driving a De Laval centrifugal gas pipeline compressor.

De Laval High Pressure Turbochargers utilizing a radically new design principle, can double the output of heavy-duty diesel, gas and dual-fuel engines *without increasing thermal loading.* • As a result of the exclusive Monorotor construction, De Laval turbochargers offer pressure ratios of 3:1 as well as far higher compressor and turbine efficiencies than those found in conventional turbocharger systems. De Laval units are self-adjusting to engine loads, can be used on 4- *and* 2-cycle engines. Other Monorotor advantages are exceptional simplicity and light weight.

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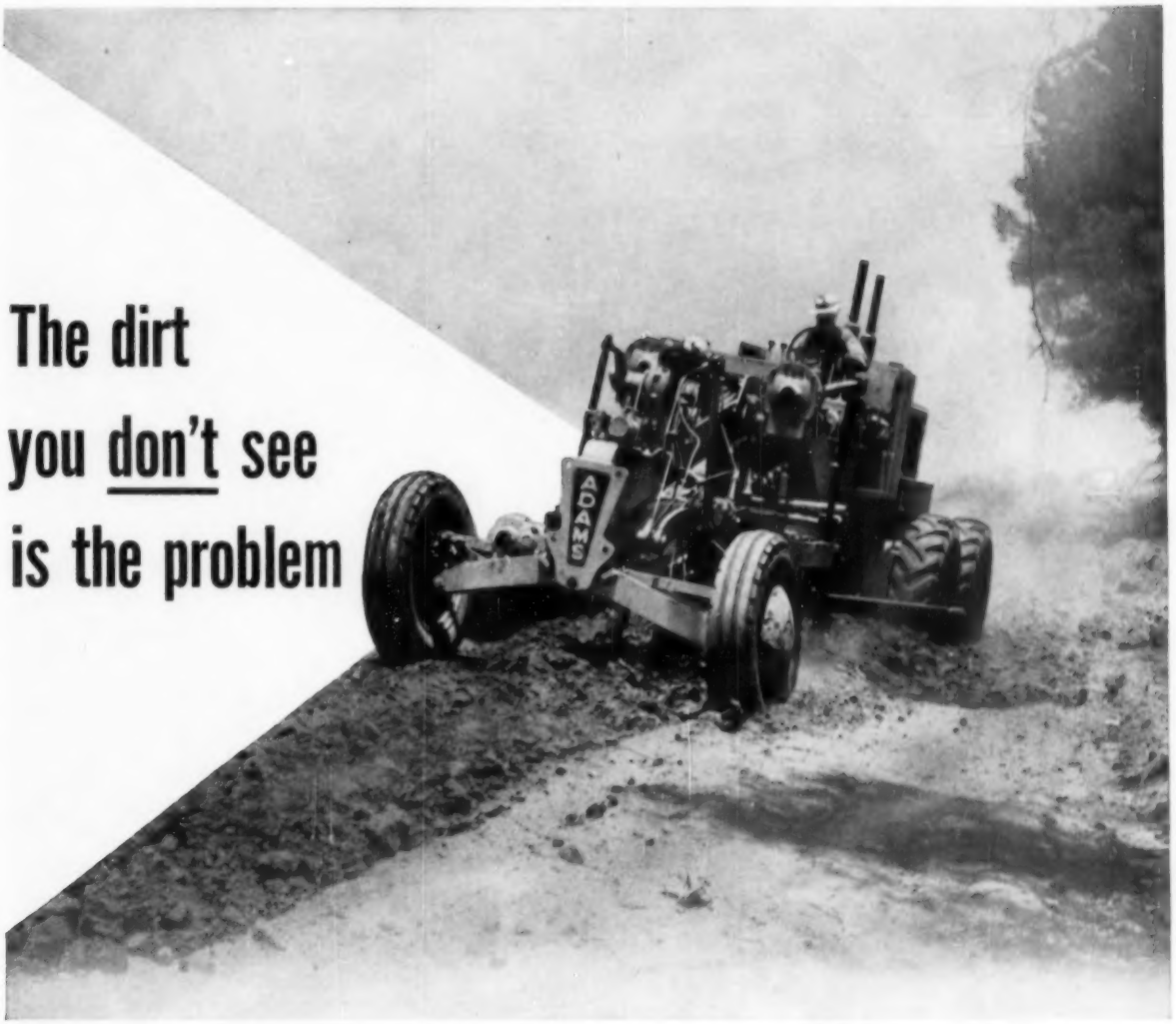

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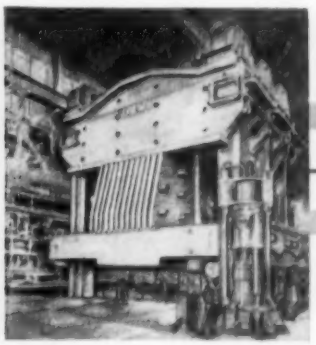

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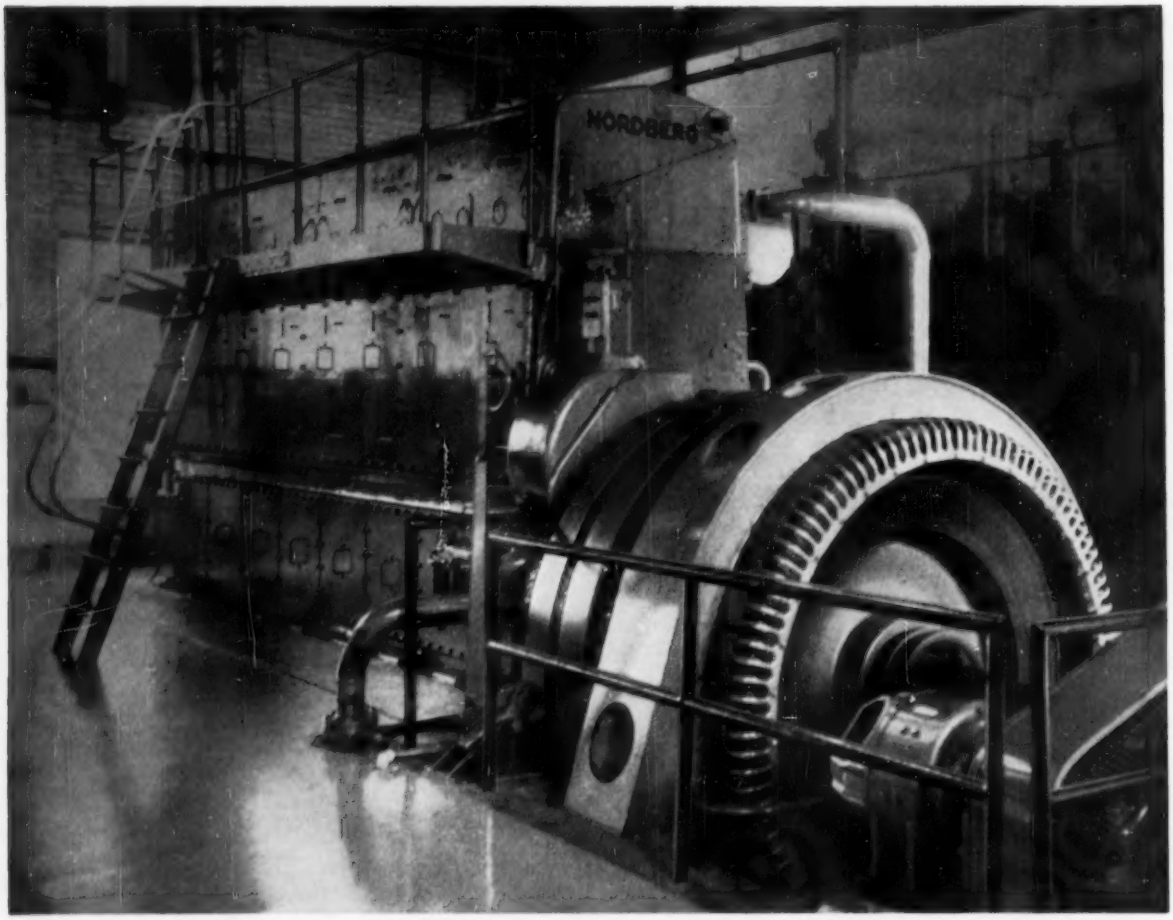

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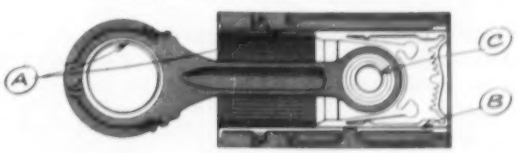

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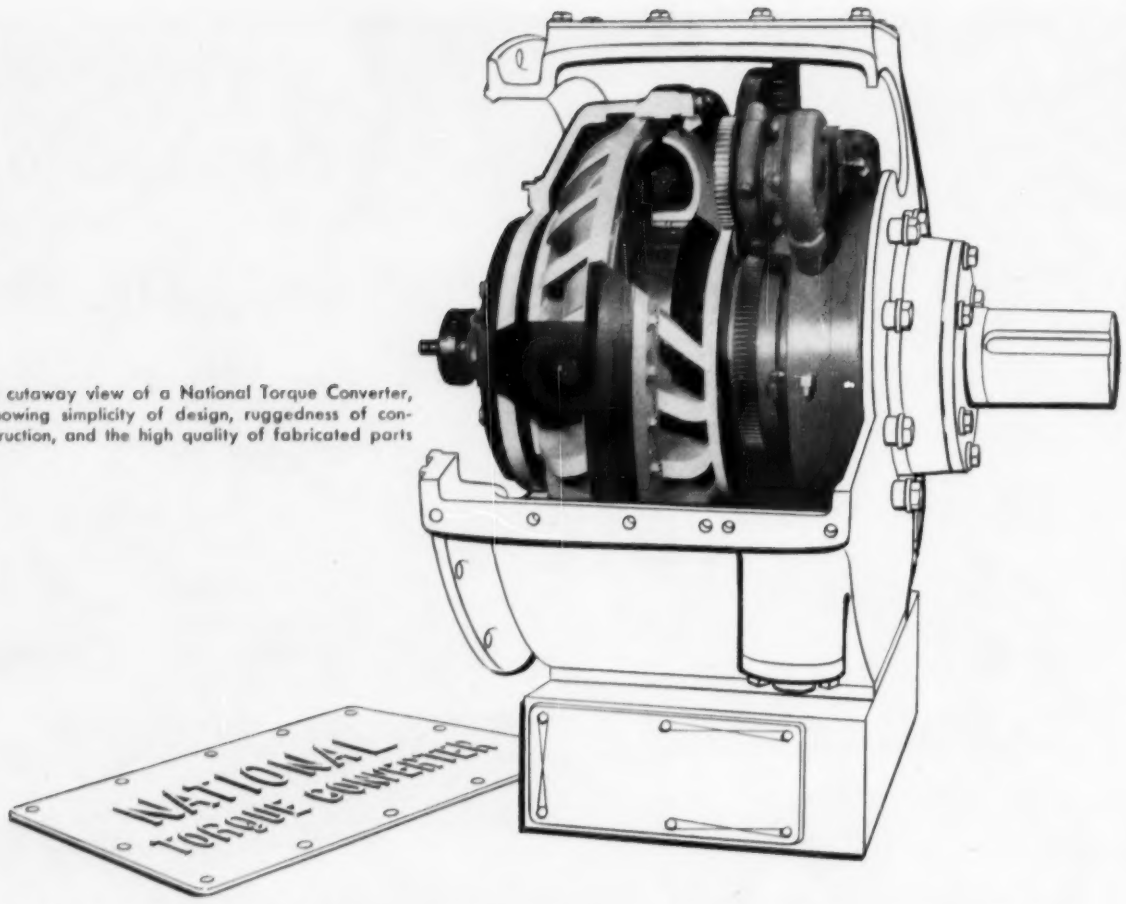


A cutaway view of a National Torque Converter, showing simplicity of design, ruggedness of construction, and the high quality of fabricated parts

It's rugged...it's durable...it's dependable...

it's a NATIONAL Torque Converter

The simple, rugged design of National Torque Converters offers many unique features.

Converter is easy to install.

Equipment service life is prolonged.

Maintenance of equipment and torque converter is at a minimum, even in the roughest, toughest industrial service.

Meets the most rugged demands of practically every heavy-duty application—oil drilling rigs, excavating, earth-handling, mining, logging and similar equipment.

In addition, precision fabrication provides uniform high efficiency permitting standardization of National Torque Converter on your equipment with assurance of uniform top performance.

And you have a choice of 6 basic hydraulic circuit sizes, each with a range of input ratings, to permit *exact matching* of torque converter to engines of 100 to 1000 horsepower.

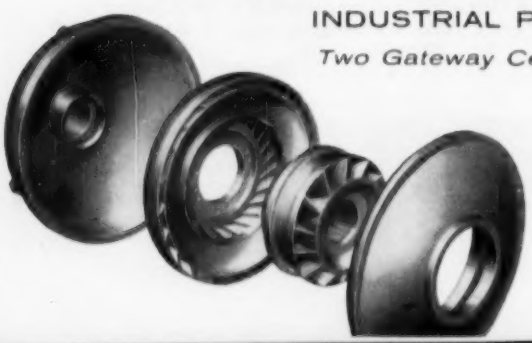
National engineers will gladly work with your designers to arrive at the correct size and capacity of National Torque Converter for the specific power-speed characteristics of your equipment. Why not call on us today?

A copy of Bulletin No. 468, descriptive of National Torque Converters, is available on request.

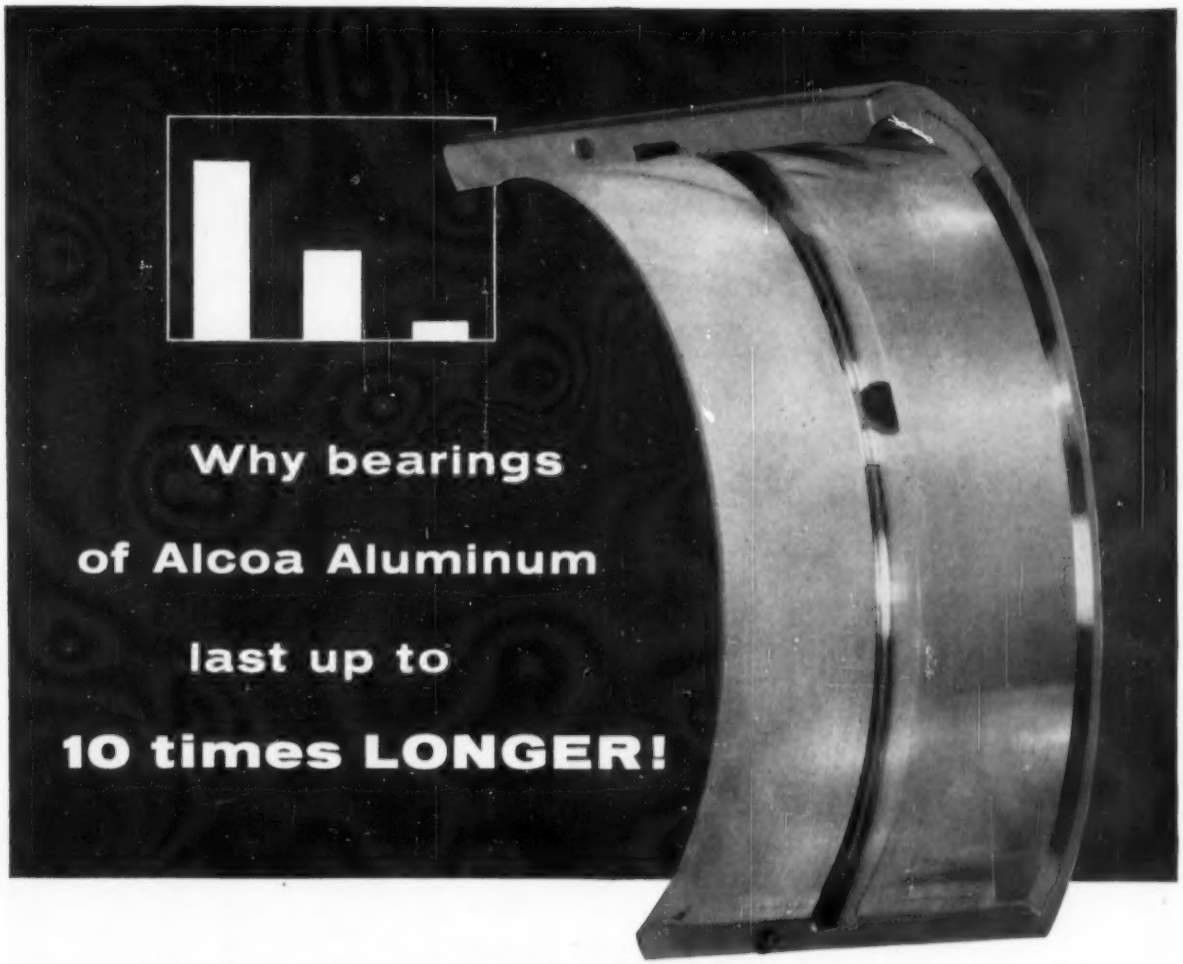
THE NATIONAL SUPPLY COMPANY

INDUSTRIAL PRODUCTS DIVISION

Two Gateway Center, Pittsburgh 22, Pa.



Pace-setters in the progress of industrial power transmission



A leading diesel engine manufacturer increased the life of their crankshaft bearings *at least 10 times* by switching from babbitt to solid bearings of Alcoa® Aluminum. Bearings of Alcoa Aluminum are outperforming babbitt and bronze in hundreds of other applications—because aluminum has an *unmatched combination of advantages.*

Highest load capacity—Solid aluminum bearings withstand the highest loads—up to 10,000 psi on projected area in certain applications. Aluminum bearings are the only solid bearings suitable for heavy-duty service.

20° cooler running—Aluminum is the best heat conductor of *all* bearing metals. Result: aluminum bearings run up to 20° cooler than other bearings. Where hot spots are likely, there's far less danger of seizure.

Excellent conformability—Aluminum has good ductility, conforms readily to misalignment of shafts or nonparallelism of pins. This reduces unit loading, makes bearings last longer.

Handles dirt well—Dirt in the oil? Aluminum embeds particles far better than bronze, but not as deeply as babbitt. Dirt particles roll out of aluminum more easily and are trapped by the filter.

No corrosion problem—With its excellent corrosion resistance, aluminum is unaffected by additives in oils. No protective coatings are needed.

No failure damage—With solid aluminum bearings, there's no chance of journal damage in event of bearing failure.

Great design flexibility—The *structural* properties of Alcoa bearing alloys give you interesting design opportunities. For example, solid aluminum connecting rods which eliminate the need for insert bushings. Full-floating bearings. Water-cooled bearings with integral cooling passages.

Carefully investigate cast bearings of solid Alcoa Aluminum. Check your bearing manufacturer or write: Aluminum Company of America, 1980 Alcoa Building, Pittsburgh 19, Pennsylvania.

Your Guide to the Best in Aluminum Value

CFC COMPLETE FILTRATION COVERAGE

there's a Commercial Filters unit engineered for your filtering job...

Fulflo FILTERS

Fulflo Filters provide optimum clarity at ultra-high flow rates. For all industrial fluids—including oils, liquid fuels, chemicals, water, compressed air and various gases. Sizes to handle flow rates up to 1,600 gpm. Pressures to 4,000 psi.

Fulflo Filters feature Honeycomb Filter Tubes, the "precision controlled density" element that filters every drop again and again to give you microscopic clarity. Choice of cotton, acetate, nylon, orlon, dacron, dynel or glass fibres.

Standard models available in steel, stainless steel, rubber lined steel or nickel-plated brass. Custom models engineered to special requirements.

Honan Crane FILTERS

Honan-Crane Filters offer "clean oil" filtration in diesel, turbine, hydraulic, metalworking and quenching operations. Bulk refill models provide depth filtration with cellulose medium for additive oils and Cranite (fullers earth) medium for straigth mineral oils. Multi-cartridge models feature six different types of cartridges that may be used interchangeably depending on type and degree of filtration desired. Flo-Pac models, installed in line, handle flow rates up to 900 gpm. All have quick-opening covers for ease in changing refills.

other CFC products

Purivac Insulating Oil Conditioners
High Pressure Hydraulic Filters
Magnetic Separators
Plating Filters
Coolant Clarifiers
Oil Burner Filters
Compressed Air Filters
Dri-Pure Water-Oil Separators
Pre-Coat Filters
Water Filters
Beverage Filters
Pharmaceutical Filters
Automatic Tubular Conveyors

FILTERS Michiana

Diesel and gasoline engines get complete protection against the damaging effects of dirty oil with Michiana Lube and Fuel Oil Filters. Designed for low cost filtration and proven in thousands of installations. "Throw-away" or repackable filter elements. Available in a wide range of sizes and models.

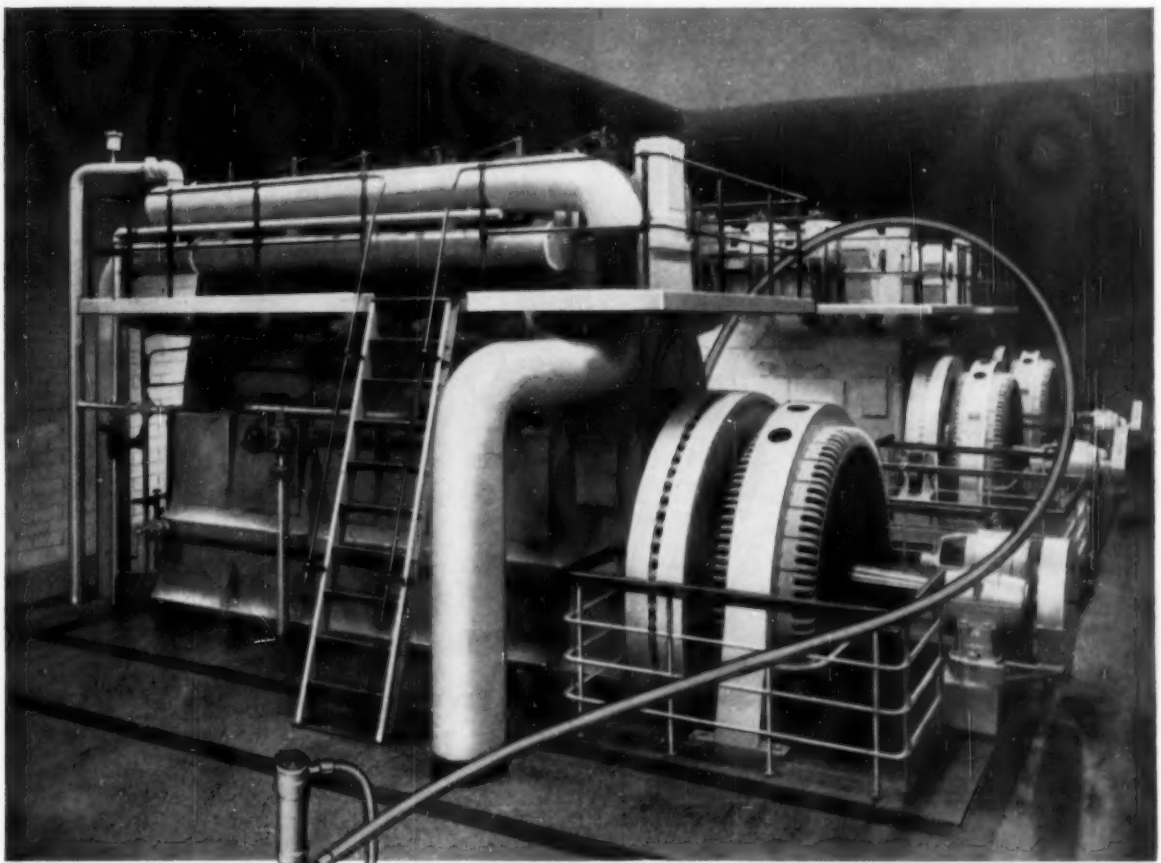
Write for literature or engineering help covering your filtration problem.

CFC

COMMERCIAL FILTERS CORPORATION

MELROSE, MASSACHUSETTS • LEBANON, INDIANA

Stops Sludge!

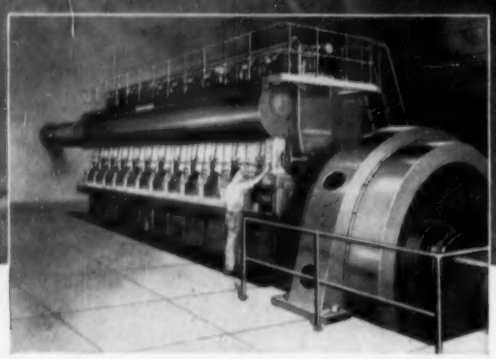


Guard your Diesel against sludge and carbon deposits – switch to Sinclair RUBILENE®, the lubricating oil with over 35 years of proven performance. RUBILENE's top quality means protection against "stuck rings"– prevents excessive wear of cylinders, pistons and other vital moving parts operating continuously for long periods. Sinclair RUBILENE pays off in reduced maintenance and less work during overhauls. Your Diesel stays on the job longer!

Switch over to RUBILENE. Regardless of the age or make of your Diesel, there's a member of Sinclair's famous RUBILENE or RUBILENE H.D. family that meets your needs exactly! Call your local Sinclair Representative or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. *There's no obligation.*

SINCLAIR

RUBILENE OILS



The crankshaft harnesses 6190 horsepower developed by this Nordberg 12 cylinder Diesel engine to generate 4840 gross kilowatts of electric power.

Forging Weight 108,460 Pounds
Finished 12 Throw Crankshaft
46,400 Pounds

FROM a giant 210,000 pound, 72 inch ingot, poured at Erie Forge & Steel, came this 12 throw crankshaft . . . the largest ever made.

Within our plant this giant was machined down to 46,400 pounds fighting weight; the finished crankshaft is 43 feet 9 inches long by 15½ inches journal diameter. Bearing surfaces are polished to a mirror finish.

It is one of many such forgings followed step by step from raw material to shipping dock within the Erie Forge & Steel Corporation's plants.

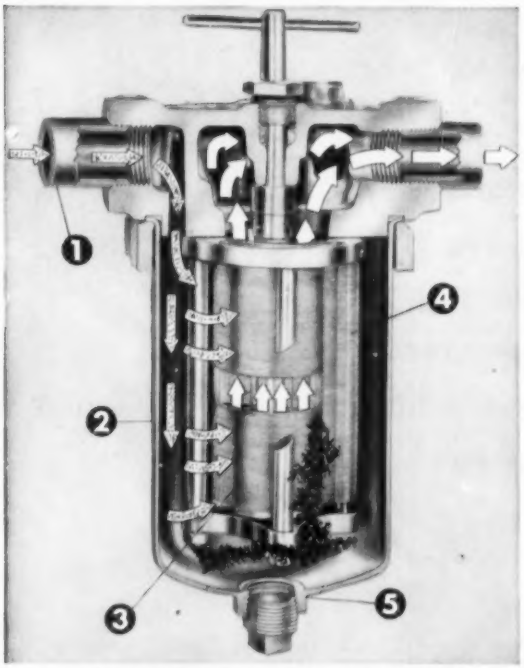
Another convincing proof of the way "One Responsibility and One Control" at Erie Forge & Steel can work for you to your specifications for steel forgings and castings.

ERIE FORGE & STEEL CORPORATION • ERIE, PENNSYLVANIA

MEMBER AMERICAN IRON AND STEEL INSTITUTE

ERIE FORGE & STEEL CORPORATION

New CUNO SUPER Auto-Klean Filter can boost engine life up to 50%



HOW IT WORKS. Dirty oil enters inlet (1) at left, fills housing (2) and flows through metal edge-type filter. (3) Clean oil rises through center of filter, leaves at right. Dirt combed out by cleaner blades (4) is removed through drain (5).

Here's what the U.S. Army has done to test Cuno's new 40-micron SUPER Auto-Klean filter for their engines:

They ran destruction tests on several identical engines equipped with different brands of filters. As they ran, dust was introduced into the air intakes. When compression fell to half its initial value, the test was stopped. Best life for engines equipped with cartridge-type filters was 60 hours.

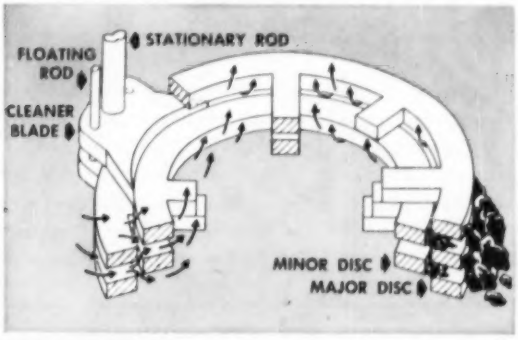
The engine with SUPER Auto-Klean ran 90 hours—50% longer—and *compression was still above half its initial value!*

You can get SUPER Auto-Klean now!

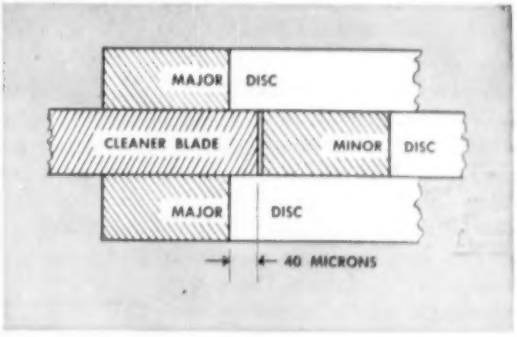
Just specify that the manufacturer equip your new diesel with this latest and best in filtration—both for fuel and full-flow lube. You'll get longer engine life and . . .

1. **Full-Flow** 40-micron filtration with a self-cleaning filter. No cartridge changes; filter can't rupture or channel.
2. **Low pressure drop.** An 8- by 2¾-inch filter element handles 30 gpm of 200 SSU lube oil with only 3 psi pressure drop. You get high capacity in a small package.
3. **All metal.** Can't absorb or adsorb additives from oil.
4. **No interruptions for cleaning.** Handles full flow all the time.
5. **Standard Auto-Klean housing.** On existing engines you can easily replace most 2¾ in. diameter cartridges with SUPER Auto-Klean or simply install SUPER Auto-Klean in the full-flow lube line following the discharge of the engine pump.

Write today for complete technical data on the new SUPER Auto-Klean for your new or existing diesel. Ask for Catalog No. SAK-057. Cuno Engineering Corporation, 909 South Vine Street, Meriden, Connecticut. 55



FILTER ELEMENT consists of stacked major and minor discs and cleaner blade bearing against precision ground minor disc. Oil flow is shown by arrows.



LARGE PARTICLES (over 0.012 in.) are stopped at space between major discs. Short 40-micron restriction stops 40-micron particles, but allows high flow rate.

CUNO

ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (edge-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound) • PORO-KLEAN (porous metal)

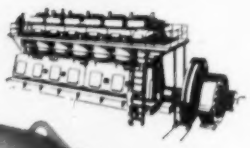
AiResearch Turbochargers

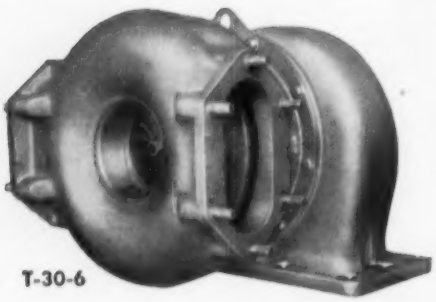
T-10

T-14

These scientifically-engineered turbochargers for your mobile, stationary or marine diesel engines are available now!

T-15





T-30-6

T-30-2

AiResearch has incorporated into the design and manufacture of its turbochargers the greatest experience in the field of small turbomachinery of any company in the world! With these results:

AiResearch turbochargers increase power up to 100%. The only limitation is the design and application of your engine.

Because they *are* air-cooled, they place no extra burden on your cooling system.

They cut fuel costs up to 20%, reduce noise and decrease or completely eliminate diesel smoking.

They're easier to maintain than any other turbochargers. A removable rotating assembly simplifies and reduces maintenance.

They allow your diesels to operate at full efficiency from sea level to more than 8000 feet.

We invite your inquiry on how you can improve the performance of your diesels by the application of AiResearch turbochargers.

BASIC SPECIFICATIONS FOR AIRESEARCH TURBOCHARGERS

MODEL	T-10	T-14	T-15	T-30-2	T-30-6
Diameter — in. nom.	9	11.5	15.25	15.25	16
Length — in.	9	14.12	16.75	17.25	21.75
Weight — lb.	40	95	125	135	195
Output — lb/min. (Standard Conditions)	25-40	35-65	35-65	70-95	115-175

THE GARRETT CORPORATION

AiResearch Industrial Division

9225 South Aviation Blvd., Los Angeles 45, California

DESIGNERS AND MANUFACTURERS OF TURBOCHARGERS AND SPECIALIZED INDUSTRIAL PRODUCTS

Do You Have Problems With ...

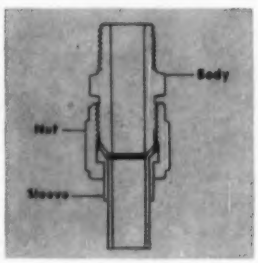
- ☑ VIBRATION
- ☑ PRESSURE
- ☑ SURGE
- ☑ TEMPERATURE
- ☑ CORROSION

Reduce your production worries to a minimum with these new Weatherhead tube fittings. Two or three-piece styles in all popular sizes.

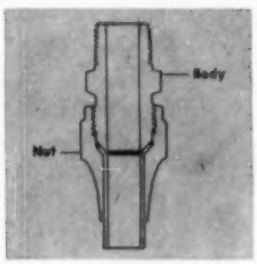
WEATHERHEAD FLARE-TWIN*

*Trade name for the new Weatherhead 37° flared fitting—SAE, JIC, and ASME approved.

Here's HOW Flare-Twin Works!



3-PIECE



2-PIECE

Here's WHY Flare-Twin Works!

VIBRATION—Sleeve acts as a dampener to resist vibration . . . also as reinforcement to tubing at critical vibration points. In the 2-piece fitting the extra-long taper on the nut does the same job as the sleeve on the 3-piece.

PRESSURE AND SURGE—Flare-Twin fittings will easily withstand normal pressures commonly encountered in most standard hydraulic systems.

TEMPERATURES—Flare-Twin fittings may be used at temperatures applicable to any hydraulic installation.

CORROSION—New Weathercote† finish is resistant to non-flammable hydraulic fluids as well as petroleum base fluids.

†WEATHERCOTE—trade name for the new Weatherhead finish—meets all SAE specs for corrosion prevention.

WEATHERHEAD *The Only Complete Hose and Fitting Line*

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FORT WAYNE, INDIANA • *In Canada: The Weatherhead Co., Ltd., St. Thomas, Ontario*

CYCOILS take the DUST,

Gulf Oil Corporation, at its Odessa, Texas, Sand Hills Plant, depends on AAF Cycoils to keep tough West Texas dust out of its valuable engines.

THIRTEEN big Ingersoll-Rand gas-engine compressors represent a big investment in fine equipment. They deserve the finest protection. And, when they're at work in oil refining, the stakes become substantially higher.

That's why you see that battery of 22 AAF Cycoils protecting the engine air intakes at the Odessa, Texas, Sand Hills Plant of Gulf Oil.

AAF Cycoil heavy-duty oil bath air cleaners provide 4-way cleaning: impingement, scrubbing, cyclonic action and filtering. Over 90% of the fine dust content in the air is trapped in oil and removed by centrifugal action before most of it even reaches the filter pads. Additional filtering pad action provides air that's virtually 100% *dust-free.*

Only Cycoil gives engines and compressors such remarkable protection. Write for Bulletin No. 130. It's the story of Cycoil Oil Bath Air Filter. And it's jam-packed with the kind of facts that save trouble . . . and money.

AAF

American Air Filter
COMPANY, INC.
445 Central Avenue, Louisville 8, Kentucky
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Type CMS Multi-Duty Filters

Type G Pipeline Air Filters

BETTER AIR IS OUR BUSINESS

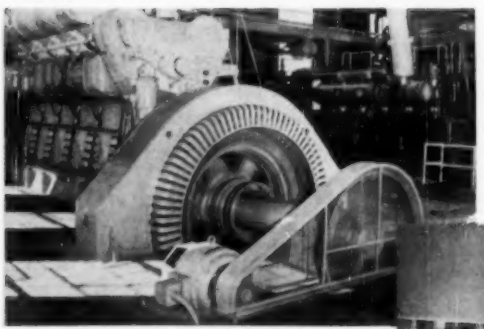
Type OCH Intake Air Filters

Cycoil Oil Bath Air Filters

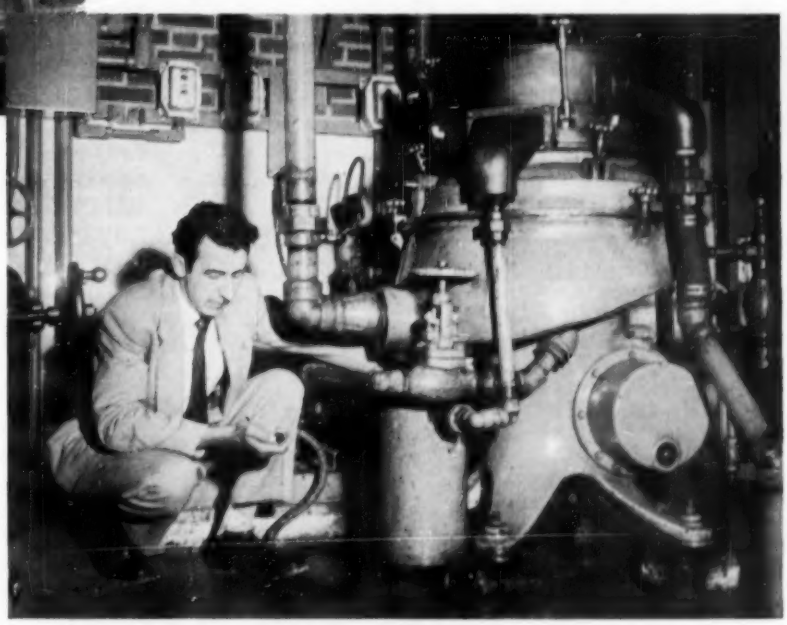
DE LAVAL AC-VO CENTRIFUGE SAVES EDMUNDSTON $30,638 IN ONE YEAR!

The City of Edmundston power plant in New Brunswick adds another story of tremendous savings through the use of residual fuel—purified by De Laval.

With #2 diesel fuel costing 15½¢, and residual 9¼¢ per gallon . . . there is a gross savings of 6¼¢ per gallon when residual fuel is used. Mr. L. Long, Electrical Superintendent says: "A total of 490,216 gallons of #6 fuel was burned from May 1, 1955 to May 1, 1956. Gross savings amounted to $30,638.50.



Baldwin-Lima-Hamilton diesel engine at City of Edmundston power plant in New Brunswick.



De Laval AC-VO "Nozzle-Matic" Continuous Purifier at City of Edmundston plant.

Mr. Long says "the De Laval AC-VO removed some 5,280 gallons of sludge. The engine operated 4912 hrs. on heavy fuel. A thorough inspection showed that fuel injection equipment, bearings, gears, etc., were in excellent condition."

Get tremendous savings with low-cost heavy fuel oil—*purified by De Laval!* Write for details . . . today!

DE LAVAL SEPARATOR COMPANY

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO. 201 E. Millbrae Ave., Millbrae, Calif.

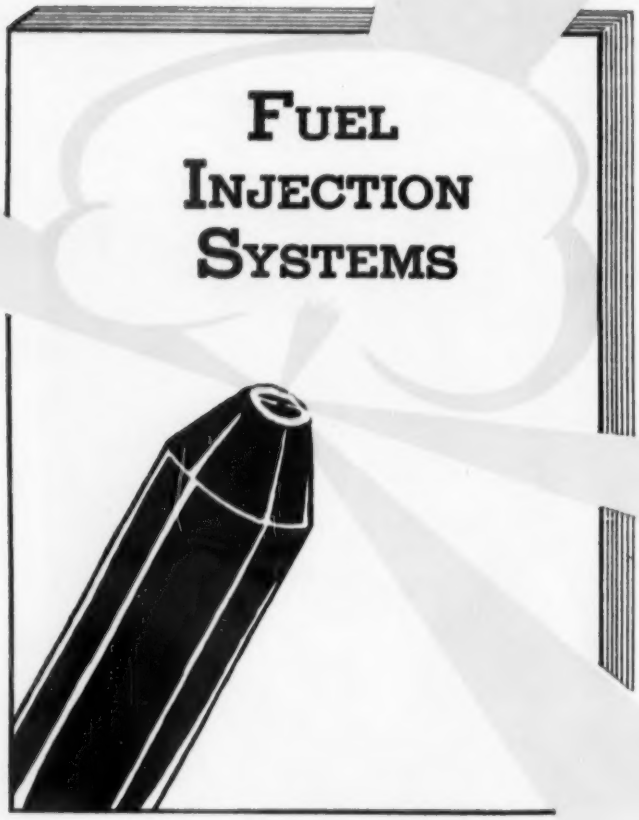
JUST OUT—

America's ONLY Guide To

Fuel Injection Design...Maintenance...Operation

COMPLETELY REVISED, the brand *new* 220 page FUEL INJECTION SYSTEMS shop manual removes the mystery from injection systems design, maintenance, and operation—

describes the many dollar-saving injection repairs that can be performed by you—and those that should be executed only by your distributor or injection repair shop.



In its profit-packed chapters you'll find the principles of operation . . . details of construction . . . details of assembly and disassembly . . . test data . . . and preventive maintenance practices of injection equipment used on all American diesels:

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CATERPILLAR
C.A.V., LIMITED
COOPER-BESSEMER
CUMMINS
FAIRBANKS-MORSE
GENERAL MOTORS
INTERNATIONAL HARVESTER
ROOSAMASTER
SHEPPARD

POPPING PRESSURE DATA—To enable you to test nozzles with the greatest efficiency, the FUEL INJECTION SYSTEMS shop manual contains an invaluable *directory of the most frequently used diesels' nozzle opening pressures—the only complete compilation of these figures available.*

Now in its Third Edition, the FUEL INJECTION SYSTEMS is read wherever diesels are built, serviced, or used. *Over 10,000 purchasers testify it is must reading for every diesel man—veteran or beginner.*

Order NOW, and put it to work for YOU. You'll want to consult it to keep abreast of the newest in fuel injection equipment . . . to know the most efficient preventive maintenance procedures . . . to perform many hitherto costly repairs yourself.

GUARANTEE—If within 10 days of the time you receive the FUEL INJECTION SYSTEMS shop manual, you find it will not help you, return it, and we'll gladly issue a full refund.

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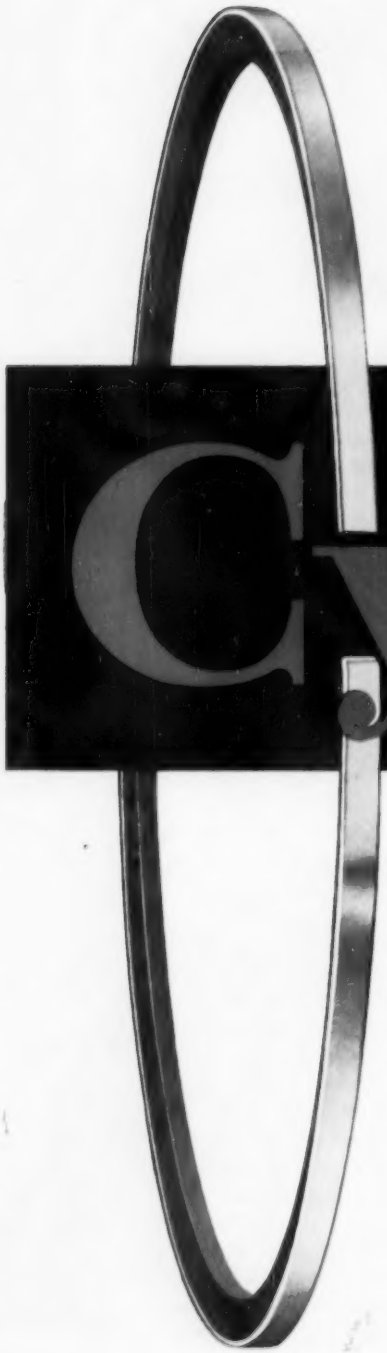
editorially speaking

Too Many Chiefs . . . .

And not enough Braves. That's descriptive of what is happening—or would happen if it could be tolerated—in a good many diesel repair shops. We ran into it when getting the "Talking Shops" story for this issue. The people interviewed put into words some thoughts that we had had for a long time. The problem is that every prospective employee wants to start at or near the top. And there is only so much room for "chiefs". It is not even a question of being qualified—and a lot of applicants aren't—it's a question of attitude, and perhaps the times. Today we hear a great deal about "seniority rights" and "promoting from within" policies. We are not going to argue the merits; we're simply stating facts. The point is that you can't have things two ways. Viewpoints on desirability of such practices seem to vary depending on whether you are "in" or "out". Most management has found that a policy of moving people up the ladder as openings occur provides an important incentive to employees. So the major chance to get "in" is at the bottom. This makes it tough on the experienced, well-qualified man; his job opportunities are narrowed down and may be geographically scattered. He has our full sympathy. But we get a lot of letters about jobs from young fellows getting out of the Armed Services or perhaps graduating from a diesel school and, frankly, we think that some of them are shooting too high. Don't misunderstand, the schools do a good job and exposure to diesels is always helpful. But even an engineering graduate doesn't start out as a project engineer; he breaks in and continues learning on routine but necessary jobs. So it has to be in the shop. There's much more room at the bottom to get "in" and there is a lot to be learned there. And at the rate that diesel usage is zooming, the promising "Braves" will soon become "Chiefs".

B P E

Sealed Power
CHROME-FACED
Cyclan



PISTON RINGS
are unequalled for Diesel engines

Cyclan ring iron, developed by Sealed Power metallurgists, has acquired an enviable reputation for Diesel service. Cyclan has many advantages, all of which are summed up in the simple, often-proved statement—CYCLAN WON'T BREAK IN SERVICE.

Now several of our Cyclan customers are ordering chrome-faced Cyclan rings, combining the heat-resistance and wear-resistance of chrome with the strength, wearing quality, resilience, and bearing characteristics of Cyclan.

This combination may be the perfect one for your Diesel engines. Sealed Power engineers will welcome an opportunity to discuss the subject with you at your convenience.

Write for "The Cyclan Story"

SEALED POWER CORPORATION • MUSKEGON, MICHIGAN • ST. JOHN'S, MICHIGAN • ROCHESTER, INDIANA
DETROIT OFFICE • 7-236 GENERAL MOTORS BUILDING • PHONE TRINITY 1-3440

SEALED POWER PISTON RINGS

Sealed Power Piston Rings

PISTONS • CYLINDER SLEEVES

Leading Manufacturer of Automotive and Industrial Piston Rings since 1911
Largest Producer of Sealing Rings for Automatic Transmissions and Power Steering Units

highlights

U. S.-Made Daimler-Benz diesels and diesel parts are expected to be produced by Studebaker-Packard, which is being backed by Curtiss-Wright. Engines will be produced under an agreement with the German firm.

Another railroad is using a two-fuel system. B & O has found that the savings accruing from the use of residual fuels warrant their use. Residuals, because of their density, have more BTU per pound, and are cheaper to buy.

Better be careful. The Soviet Union produced just as many Ph.D's as we did during 1953. The big difference came in the fields of work.
U. S. degrees were 2.3-to-one in favor of the humanities, while in the Soviet Union science and engineering were favored 3-to-one.

Automatic transmission are popular in fields other than automotive. In 1947, the ratio for non-automotive use was 15-friction type to 5-automatic. In 1954, the ratio was 18-friction type to 14-automatic. Looks like efficiency of the automatic transmission is keeping pace with the increasing efficiency of the diesel engine.

Don't put your slide rules away, boys. Automation has merely shifted the emphasis. Stevens Institute of Technology has instituted a graduate program in the design, selection and operation of computers. An M. S. degree culminates the course, and the new scientific masters will face the problems introduced by the use of computing devices.

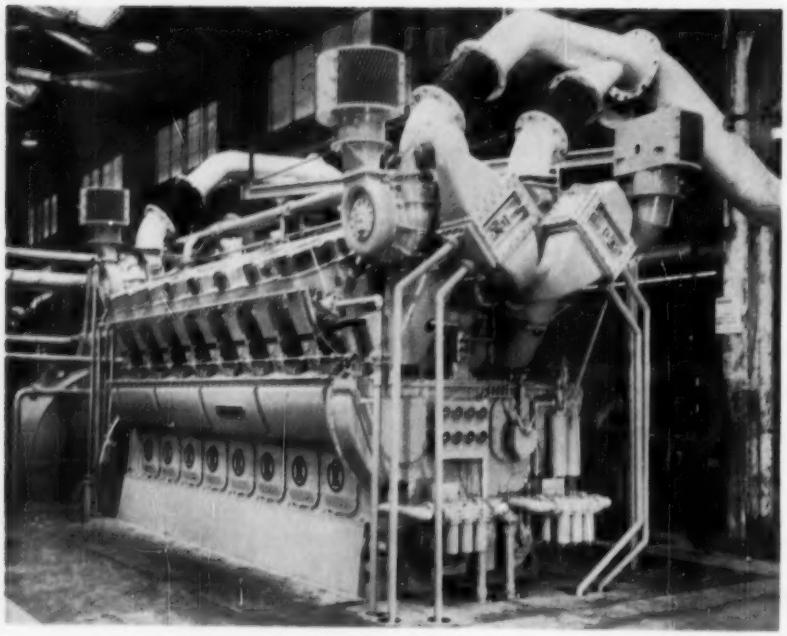
Don't throw that old, diesel piston away. The Vancouver (Canada) Art Gallery says pistons make very good flower pots.

High-speed diesel engine sales are up. Cummins Engine Company, and its wholly-owned subsidiaries, reports that sales in the first six months of 1956 were 37% above those of the comparable period last year. Cummins expects that this trend will continue.

Soon there'll be pipelines for everything. Coal will be flowing with water over the hills of Ohio within a few months, running 108-mi from Cadiz to Cleveland. The coal, pulverized and suspended in water, will be pumped through a 10-in pipeline at about 3½-mph, then dried for use.

Safe trails through the arctic by electronic technique has been developed by Army Engineers. A system of two parallel wires and a vehicular-mounted radio-type receiver has been successfully tested on the Greenland ice-cap. Alternating current is fed to the wires on either side of the trail to mark the route electrically. The receiver tracks the vehicle through the wires.

Looks like diesels will be used in subs for a while, if present orders mean anything. The Electric Storage Battery Company has been awarded a contract in excess of three-million dollars for submarine storage batteries for the navy. This is in addition to a contract for more than five-million dollars worth of submarine batteries received earlier this year. Takes a lot of diesels to charge that many batteries.



SPECIFICATIONS

	RV-16-3
Number of Cylinders	16
Displacement (cubic inches)	76,266
Number Main Bearings	9
Horsepower, Diesel	3852-7703
Horsepower, Dual Fuel	3852-7703
Horsepower Spark Ignition	3852-7703
RPM	200-400
Piston Speed	700-1400

WEIGHTS (approximate)
(with Standard Flywheel)

Bare Engine	189,100 lbs.
Skidded Engine	201,100 lbs.
Box Weight	206,100 lbs.

Dimensions

Max Lg+Turboc'gs	316"
Max Wd.	112"
Max Ht.(from base)	145"

New 16-cyl, 7703-hp, RV-16 is shown on test stand connected to new Enterprise $250,000 hydraulic dynamometer (at left background). Two of the four Brown Boveri VTR 320 turbochargers (one on each engine corner) can be seen on left side of engine. Air intercoolers and compact arrangement of manifolding and inlet and exhaust headers can be seen at right end of the engine.

Enterprise Builds Powerful Vee

Big in horsepower—small in size; "old" in components—new in configuration; time-tested materials & techniques—new in application for diesel; liberal in capacity—conservative in design. These paradoxes are found in the new Enterprise RV-16.

ENTERPRISE has completed the prototype of its first vee-type diesel engine. Following the trend for more power from less bulk, this 16-cyl engine is rated 7700-hp at 400-rpm. It is claimed to be 20% shorter and 30% lighter than a corresponding in-line engine of equal power. It is the first of a new line of engines, and the design improvements offer some interesting ideas.

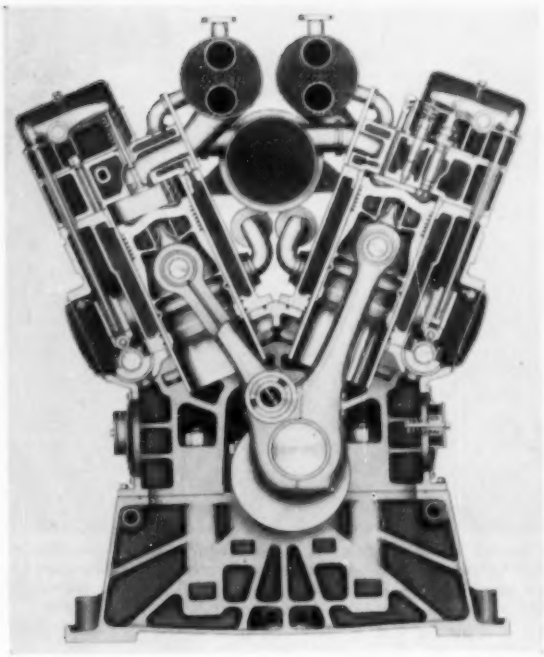
But building an engine that is radically new and different is one thing. Building acceptance for it is something quite different. It might be said as a practical matter that the first is easier than the second, at least in the diesel field. The result is compromise, which in diesel technology has meant carefully measured progress. Each new advance is always made against a firm, tested background of successful application.

So it is with the Enterprise RV-16. This engine was assembled last year and put through its dynamometer tests this spring and summer. It's the most powerful engine yet built by the Enterprise and it's considerably different from anything they've made before.

The RV-16 is claimed to be the industry's smallest diesel when comparing its length and weight to its output. This is verified by comparing its dimensions and output with published specifications for heavy-duty diesels. So there's bound to be a difference or two. One big difference is the matter of length. This is mostly, attributed to one feature, the unique master-and-link connecting rod design which permits opposing cylinders in the vee-banks to lie in the same plane.

Master-and-link designs have been successfully applied before but refinements in the Enterprise engineering approach show up in the RV-16's performance. Low bearing pressures, for example, are possible as the result of unusual handling of crankpin fillets. Lube oil cooling is made more efficient through use of the crankpin as a rotary valve.

But against these points of difference between the new RV-16 and its predecessors there must be weighed its strong design and construction conservatism. The clue here is the engine's designation "RV"—which means, in short, a vee-model of the service-proved Enterprise R-series. In many ways, the man who buys a RV-16 really buys a pair of 8-cyl R engines bent into a new shape. He gets the benefit of a lot of interchangeability, too. Enterprise had that in mind when the RV design began over two years ago.



This master and link articulated connecting rod design permits opposite cylinders in the vee to lie in the same plane. This makes the overall engine length more than 20% less than a corresponding in-line engine of equal power.

Cutaway view shows arrangement of master and link connecting rods as well as piston, cylinder head, and manifold construction. After disconnecting master and link con rods at serrated joint by removing six bolts, each rod can be removed through the cylinder liner.

Early Beginnings

Actually, the history of what became the RV-16 began more than two years ago. That history is continuing right now, it's industry's demand for efficient power plants of higher and higher power and performance capabilities. Enterprise wanted to develop an engine of 4000-hp or better. And the question immediately became how best to do it.

The first point to be decided was the matter of total cylinder capacity required to develop 4000-hp within a clean exhaust limit. This, of course, depended both upon breathing capacity and upon the maximum speed that would provide durability and reliability.

Calculations showed that a 20-in bore and 25-in stroke, with eight, 4-cycle cylinders in line, would give 4000-hp at 315-rpm. Over-all length would run nearly 31-ft. And it was this dimension that threw out the in-line design.

Structural rigidity is a "must" in any diesel engine. On this depends smoothness of running and durability of wearing parts. In effect, this means keeping the engine as short as possible and still have adequate crankshaft bearing areas and adequate cylinder and head cooling. To hold the length down, Enterprise looked at other alternatives such as higher speeds, v.e-block design, etc.

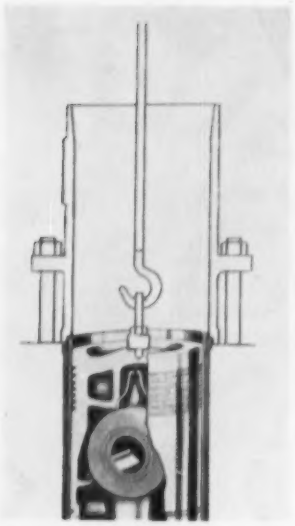
R-Series Background

Here, today's RV-16 really got its start. The existing R-series engine had been proven in all performance respects. So its 17-in bore and 21-in stroke were adopted for the new engine. This assured adequate cooling. Also, the 24-in cylinder center distance of the R-series engines meant that an RV-16 would achieve the required structural rigidity.

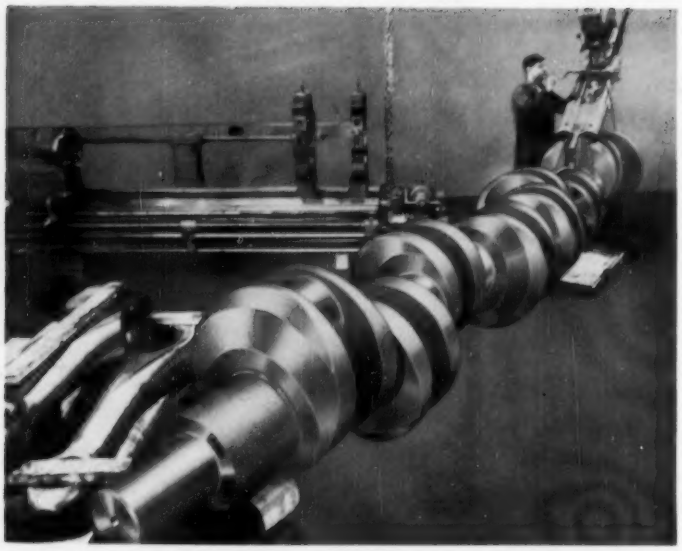
The main problem now lay in a connecting rod design. To make the best of the articulated rod configuration which was an obvious necessity, and to provide conservative bearing and bushing loads were the problems.

Many sketches and doodles were made before preliminary layouts were started. Then this work saw definite criteria take shape;

Special tool is used to support piston during installation of piston and rod in the cylinder. Rack tooth joint distributes the joint stresses over greatest possible area.



Piston is shown being removed from cylinder with the help of a special tool which supports and protects it.



Man is shown drilling oil holes in RV-16 crankshaft. Note circular webs. "Re-entrant fillet" at junction of crank web and crank pin makes entire crank pin available for bearing surface thus keeping bearing loads low. Main journal diameter is 13-in, crank pins are 12-in. The crankshaft is machined all over.

(1) Removal of con rod from engine should be possible without removal of cylinder liner.

(2) Over-all engine lengths should be a minimum to take full advantage of the vee-configuration.

(3) Bearing loadings should be conservative.

Fork-and-blade rods were ruled out because they would add some 2-ft to engine length just to make room on the crankshaft for the required number of bolts and boss metal. Conventional, or at least, existing articulated rod designs show less link pin bearing area than piston pin area. This meant taking a new departure since Enterprise felt that this inconsistency should be overcome. Also, the usual vee-engine con rod has such a big bearing box bolted to it that the rod and bearing cannot be pulled for maintenance or replacement without removal of the cylinder liner.

Master-and-Link Features

Finally, Enterprise designers hit upon the design that fulfilled all their requirements. It is an articulated rod with the angular split having serrated surface. Here is what it means:

(1) Removal of six bolts permits the master rod to be pulled from one cylinder liner, while the link rod and its half of the box are removed through the cylinder liner in the opposite bank.

(2) There is no increase in crankshaft or engine length. (Side-by-side rods having the same load carrying capacity would have increased the engine length 3½-ft. Fork-and-blade rods, as given above, 2¼-ft.)

The crankshaft remains very rigid. In fact, the main journals and crankpins were both increased 1-in in diameter. (Mains are 13-in, crankpins 12-in.) The crankshaft has a 2-in overlap of crankpin and journal rims at the circular crank webs for additional strength at traditional points of stress concentration.

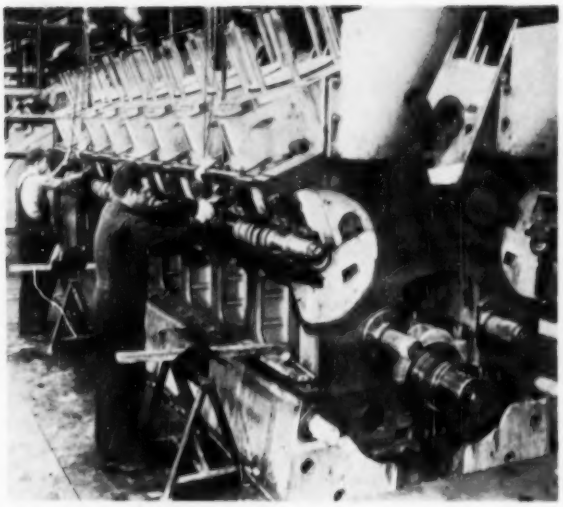
(3) Bearing loadings were held to extremely low values by two means. Foremost is the "re-entrant fillet" machined at the junction of crank web and crank pin surfaces (and permissible only because of an extremely rigid crankshaft). Its effect is to make the entire length of crank pin (less clearances, of course) available for a bearing surface. This feature plus the increased pin diameter, give 60% more projected bearing area.

The second means of limiting bearing values was omission of an oil groove in the upper bearing shell. (The groove is also absent from the lower half of the main bearings.) This increased bearing load capacity 36%.

It is these features that give the RV-16 a calculated load carrying capacity 2.8 times that of the Enterprise R-series diesels.

Silver and Chrome Bearings

The link rod pin and retaining ring bearing materials are worth further mention. Enterprise engineers turned to established practices of aircraft engine manufacturers in the design of these elements, using chromium and silver plated surfaces. There are several advantages in using these metals. The most important is performance. Stress allowables are higher, life is longer. In addition, the plated surfaces are more easily replaced than conventional case-hardened steel. Also, with con rods of this size and weight, plated surfaces avoid all problems of distortion in treatment and the occurrence of grinding checks associated with case hardening.



Camshaft is shown being installed on RV-16. Locating of all headers and manifolds in the 45-deg vee between cylinder blocks makes engine parts easily accessible for inspection, servicing and repair.

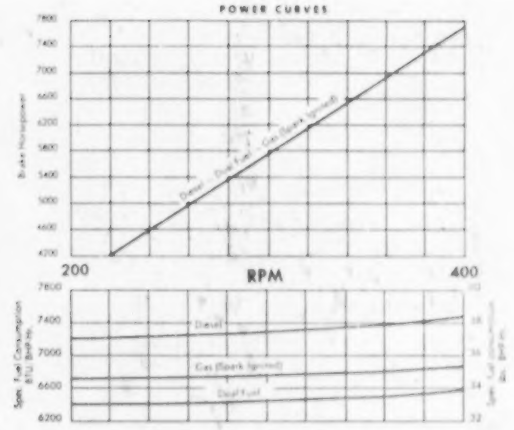
Engine size most directly affected design of the RV-16 frame. Continuing the parallel of this engine to its in-line R-series predecessors, the basis for design would be a simple pair of elements, base and cylinder block. Obviously, the RV would have two blocks. But, in addition, for ease in manufacture, shipment and installation, the frame was further divided to include separate base and crankcase. The blocks, however, are absolutely identical and can be turned end for end and installed on either cylinder bank.

Some aspects of engine construction were developed with accessibility as the main goal, as has been noted in the master-and-link rod arrangement. For convenience, tappets, camshafts, fuel pumps, etc., are all unobstructed by piping. All manifolding and headers are located inside the vee and out of the way. Along with the narrow vee-angle of the engine, this contributes to minimized width. (This dimension controls the 9-ft, 4-in width, although the base is at the same time nearly as wide, in the interest of stability.)

Summary

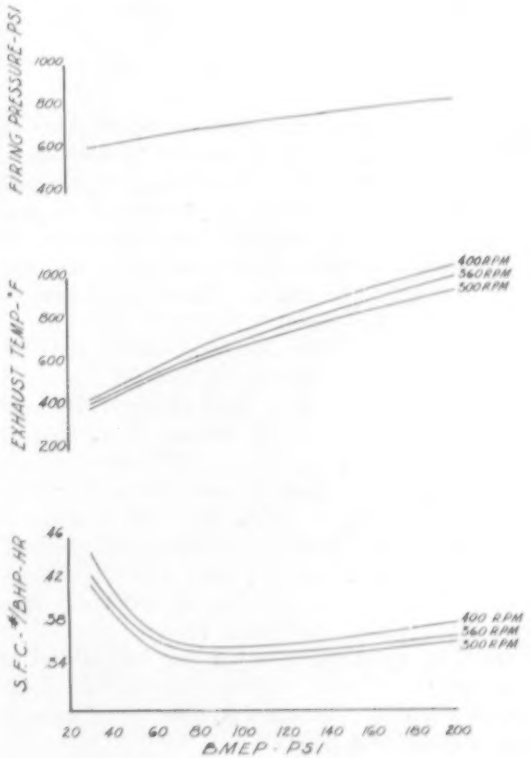
The RV-16 is a very new engine, in terms of power versus size. Yet it achieves this status by a clever combination of components that have, for the most part, seen long and dependable service in other models of the Enterprise line. Its major unique element, the master-and-link connecting rod design, has been shown to be conservative. This rod is the means of getting a surprisingly small engine for its power output.

The RV-16 was designed under the direction of Bruce Robbins, Manager of Engineering, and John Sheusner, Manager of Operations at Enterprise Engine & Machinery Co. Principal engineers who worked on various phases of the development were Don Morris, Henry Hirvo, and Harold Schilling.

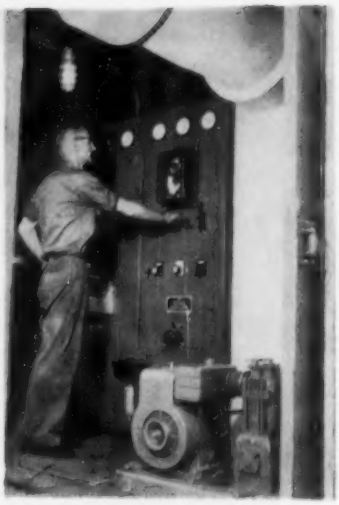


Power curves for RV-16 show horsepower output to be the same whether engine operates as diesel, dual-fuel or spark ignition gas engine. Specific fuel consumption can be figured out for each.

This prototype engine has been sold to the government of Saudi Arabia. The ensuing series will be available in as many versions as possible. Normally-aspirated or turbocharged, the "RV" can be furnished to operate on diesel or heavy fuel. It can function as a dual-fuel engine, as a spark-ignited gas engine, or as a tri-fuel plant (diesel fuel; pilot-oil-gas; or spark-ignited gas). The comparatively small size in relation to output has already attracted considerable attention.



First of two 500-kw mobile units leaves the White Diesel Engine Div. plant for Venezuela. White 3000 Series tractor pulls the trailer which permanently houses 25-ton units. Tank (280-gal) under trailer holds enough fuel for 12-hr operation at capacity. Tractor is removed after unit is located at working site.



One man can operate each 500-kw mobile generator set by means of a single electrical control panel. Entire output of unit is regulated by this control panel.

Mobile Generator Sets—Answer to Power Shortages

Mobile diesel generator sets are paying their way for peaking, emergency use and in areas beyond power lines, both here and abroad. Venezuela buys two White mobile units for just these purposes.

MANY Latin American nations are rapidly expanding their industry. The result is a need for more electric power as fast as possible. A typical example is Venezuela where power demands have expanded beyond the capacity of existing transmission lines. As replacement power for areas where power lines and systems are either being rerouted or expanded, mobile diesel generator sets seem to be the answer.

Typical of the mobile units being purchased by Venezuela are two 500-kw sets capable of furnishing normal power needs for a town of 2500 people. These units, designed in cooperation with officials of the Corporation Venezolana De Fomento, were engineered and built by the White Diesel Engine Div. of the White Motor Co. According to White, the units are the result of several years of research on mobile power plants.

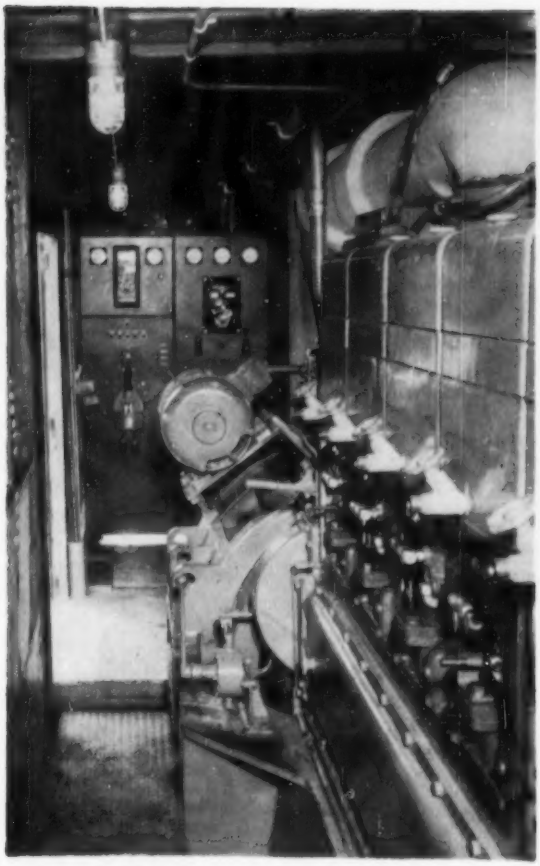
Trailers of 32-ft length, 8-ft width and 12½-ft height house the generator sets permanently. Gasoline-powered White tractors haul the trailers wherever needed. For example, the diesel generator sets can be used for reserve power for hospitals, telephone companies, peak load requirements and as emergency power where transmission equipment has failed.

The generators are driven by the Model 40 Superior diesels recently improved by White. These improvements increased the overall capacity of the 8-cyl Model 40 engines nearly 50% to 1025-hp at 1100-rpm, yet the engine size remains the same. However, for each of the 8-cyl, 8½-in bore, 10½-in stroke Superiors used on these mobile units the rating is 712-hp at 900-rpm. Open chamber combustion on these improved Model 40 engines gives better fuel economy. Re-designed intake and exhaust ports in these 4-cycle engines induce a good swirl for better mixing of air with fuel.

The engines for the mobile units have been engineered for dual-fuel operation. They can be run on 100% fuel oil, or natural gas with pilot fuel injection for ignition. Since the engines can operate on low-quality diesel fuels, even remote areas are practically assured of a fuel source.

Both generator units are self-sufficient once the 280-gal fuel tank in the trailer's belly is filled. Each tank hold enough fuel to run the engines at full load for 12 hours.

After the unit is located at the site where power is needed, the tractor is removed and the trailer is left



Spacious walkways on all sides of 712-hp, 900-rpm, Model 40 Superior diesel permit easy inspection. Louvers on both sides of trailer give adequate ventilation. Doors make entrance easy.

standing on its front landing gears and two rear jacks. The jacks take the weight off the rear wheels to keep the trailer from moving. Cables from the generator are then hooked to a transformer on the power lines or at a sub-station. The units are then ready for action in a matter of minutes.

Only one man is needed to operate each mobile generator set by means of its single electrical distribution control panel. The entire output of the 3-phase, 60-cycle, 2400-v generators are regulated by this control panel.

The trailers housing the 25-ton units are strengthened in the chassis and sides to minimize vibration during operation. Wide walkways on all sides of the generator sets permit easy inspection. Louvers on both sides of the trailer give adequate ventilation for the operator. Doors on either side make entrance to the trailers easy.

The complete mobile unit is designed to be made as economically as possible. All essential parts are standard production items and can be mass-produced. For example, the tractor is a White 3000 Series unit. As for the engines, an assembly line has been established at White's Springfield plant to build any number of these units required.

Diesels Power Ore-Carriers in Modern Mines

A rugged, little, diesel-powered ore-carrier can be seen at many modern mining sites. This is the Scott-Crete, manufactured by Getman Bros. of South Haven, Michigan.

Designed for efficiency of operation, one man can load, drive, and dump the ore-carrier by himself. It will carry loads as heavy as 3500-lb at speeds up to 15-mph.

Engine is a model 2L612 Deutz air-cooled diesel. Of 4-cycle design, its two cylinders develop 20-hp continuous at 2000-rpm. These engines are imported to this country by Diesel Energy Corp., and are made by Kloeckner-Humboldt-Deutz in Cologne, Germany. Deutz has made more than 200,000 of these air cooled units since 1948.

Cooling system consists of an axial-flow blower directing air through ducts over cooling fins. Flow of the cooling air is a function of rpm. Design temperature of power assembly components is maintained even under severe operating conditions.

The uranium mines in Colorado, Utah, and New Mexico have been using over 100 diesel-powered Scott-Cretes. They have been employed in all phases of operation—inside, outside and underground. Their extreme maneuverability (they can turn in their own length) lets them work in close quarters, and their narrow width gives them access to narrow openings and narrow trails. They operate successfully over very rough terrain.

Heavy-duty pneumatic tires provide sure grip on any surface. In addition, the two drive wheels are located directly under the load. Engine is powerful enough to drive Scott-Crete up grades as steep as 25%, and to give good performance characteristics under all operating conditions.

Engines being rebuilt enter at far rear and proceed right through shop. Test stand is behind camera, big crankshaft regrinder is at left out of picture with smaller one at right beyond parts room. In foreground valves are undergoing hydrostatic test.

Talking Shops

Another of Diesel Power's interviews with shop managers. This was a visit to an independent engine rebuilding shop to explore their techniques and tooling, their general method of operation and the thinking behind it.

OVER in Fairview, New Jersey, right across the river from New York City is the shop of Motor Rebuilders, Parts and Mach., Inc. They specialize in engine rebuilding, both diesels and gasoline engines. Their extensive stock of parts would do credit to most jobbers but it is principally for their own use; a minor part of their turnover is in resale. Then because of their special-process tooling—metal spraying, grinding, honing, etc.—some work is done for other industries. Hence the name.

The shop's proprieter is George Allaria and his son, Roy, is the general manager. Frank Bevacqua is the shop manager. Dick Bard heads up sales and it was he who outlined their area of coverage. Engines come in for rebuild from New Jersey, parts of Pennsylvania, New York, Connecticut and even up into Massachusetts.

Most of the engines handled are of the heavy-duty truck and bus sizes and types with a good sprinklin of larger engines such as the Cummins "L" models, 1879 Buda's and Caterpillar D-13000's. Tooling is available to handle engines of this general size right from preliminary cleaning to final testing after rebuild. Components of larger engines (large Baldwin engine crankshafts have been reground) can be handled on a "job" basis.

In a round-table session preliminary to getting out into the shop, general problems were discussed. It turned out that Motor Rebuild has two major ones—space and men.

The building faces a street front and rear, making it excellent for straight-line work flow. But as the business expanded, the desirability of getting additional space was apparent. Every effort to get adjacent area failed. They still have room for efficient operation but little excess. A two-location arrangement or an expensive relocation must be faced as they grow.

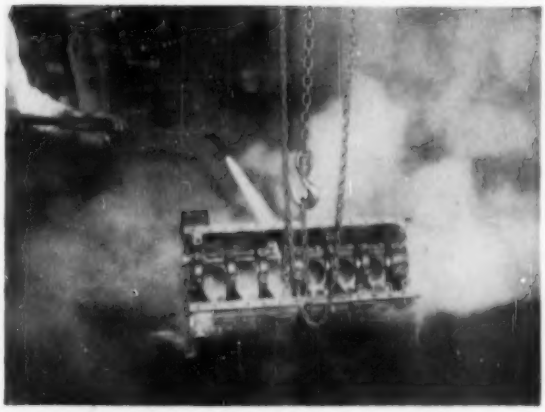
Their advice to others is to make long-range plans for space when setting up a shop.

As to men, the story is that everyone wants to start at the top. There can only be so many assemblers and machinists and policy is to fill these jobs with men working up from the cleaning, engine tear-down and miscellaneous operations. The big problem is to fill the bottom.

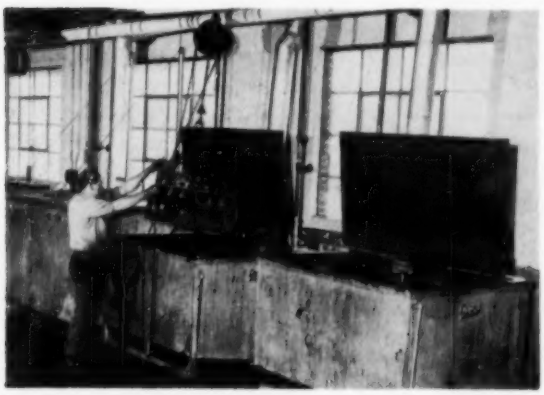
Now let's see what goes on in the shop. Shop manager Frank Bevacqua is answering the questions.

"Frank, do you have a flow chart showing how an engine goes through the shop?"
"WE don't need one. All you have to do is start at the back where engines come in and follow the overhead monorail. It was laid out to carry heavy engine parts to the different work bays until finally the finished engine is taken out the front door. With several hoists and the system of switches we can route everything and also get lifting where we want it."

"Now, is there a difference in handling large engines as compared to those small ones over there?"
"No. Procedures are the same if it's a $200 or a $2000 job. You can only have one standard. Give some leeway on a small low-cost engine and soon you'll find that it's being taken on an expensive, more-critical job."



Steam cleaner is used after machining and grinding operations. It is also handy for quick cleaning of all engine components.



Aluminum parts are cleaned in first tank at left, ferrous parts are cleaned in one of the other two tanks as required by size.

"So what's the first step when an engine comes in?"
"They are stripped and degreased. All parts are kept together and stamped with a job number assigned by the parts room. We use a hot alkaline dip for degreasing with separate cleaning compounds used for iron and steel parts and those of aluminum. Here are two 450-gal gas-fired tanks, one for ferrous parts, the other for aluminum. The big 850-gal tank is set up for cleaning big iron and steel items.

"Then we have a steam cleaner for quick cleaning of smaller items and also for recleaning parts after machining operations. It's a handy general utility machine. Cleaning is done over a drain. A special arrangement was made with the city to drain dirty material into the sewer and it is certainly convenient."

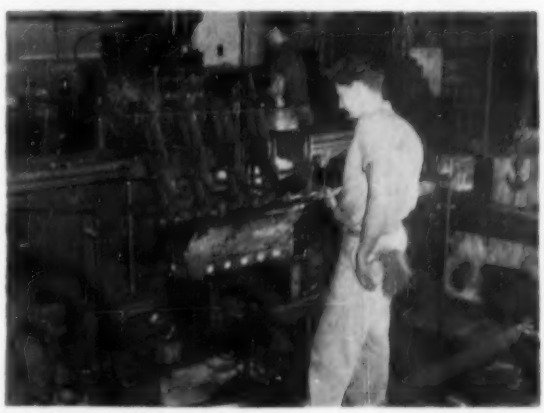
"What about inspection of the parts?"
"The tear-down man checks over the parts by eye to pick up any obvious flaws but the machinist working on the parts makes the precision inspection. Incidently the parts room men follow all inspection closely so they can jump right on ordering parts not in stock."

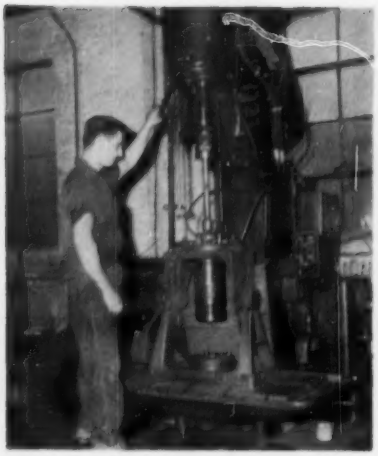
"What's that man doing with the torch?"
"He's burning out an oil passage. It's important to see that all oil passages are clear. If the solution won't clean them, we 'rod' them when we can and burn out those we can't."

"Your line spreads out now. How does it work?"
"Well, blocks stop right here for a complete check. On one side we have our hones for block bores and liners; on the other side pistons and rods are reworked.

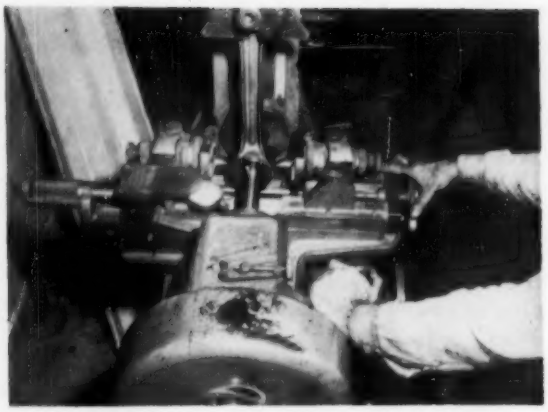
"Blocks are checked carefully for cracks and we examine the bores. With some thin-wall liners a little distortion in the bore will show up in the liner when it is installed. We check the flange counterbores for size and squareness, check the seal-ring area and generally see that the bore is straight and round.

Small engine block is set on the line boring machine. When it is necessary, camshaft bushings and main bearing saddles are also bored when the engine block is still on the boring machine.





One of two precision hones. One handles block bores while the one shown above has adapters which hold liners in place during honing.



Piston pin bushings are bored to provide exact desired clearance. The tool is set by a comparator system to bore a hole of exact diameter of the pin to be used. Final tool setting is then made by a micrometer adjustment to provide desired clearance.

"Another important job is to check bearing saddle alignment. With some engines it is standard practice to surface grind the face of the caps, torque them in place, and line bore the saddles. We set the bar to favor the block-side so as not to upset gear train clearances. From experience we know which engines to give the full treatment and which to just check.

"Blocks are set up in the line boring machine. At the same time we can line bore the camshaft bushings. Doing both jobs together cuts handling of the block in and out of the machine."

"What about the liners?"

"We have two micromatic hones. One is set up to hone bores in blocks and the other has a set of adapters to hold liners during honing. We hone liner bores to standard oversizes and make them straight and round. We also control finish by grit selection for the honing stones."

"This 'oversize' versus 'new' is always a good way to start an argument. What's your thinking?"

"We like the honing or we wouldn't have bought these big machines. We feel that an undamaged liner that will clean up in a reasonable oversize is the best bet. It is fully seasoned and any original internal stresses have calmed down. Chances are that at rebuild, you'll need new pistons anyway and costs for oversize are negligible. We think it gives a better job and saves money. Most of our customers like the results. Of course, we get some that specify new liners, so they get them.

"Frequently we have to face off a distorted block. With this metal removed, liners would extend out too far. We machine the counterbore to the right depth and see that it's square with the bore. We're getting into assembly now but a lot of this fitting must take place right here. There's more to it than just dropping the liner into a hole.

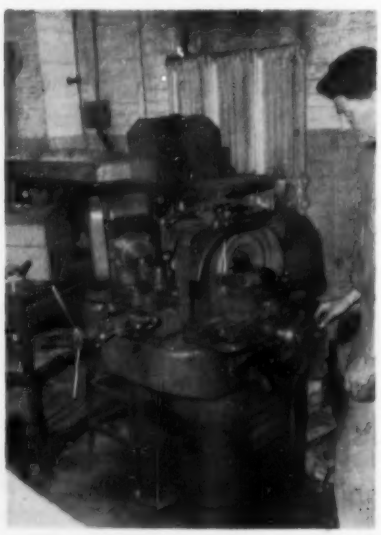
"We install liners and torque them into place with a clamping jig. On wet liners we leave out the sealing rings to check clearance at the sealing area. We can also check the protrusion and the flange-to-counterbore radial clearance. By miking the liner bore, particularly on dry-types, you can see that there is no distortion from the block hole."

"Now, about the pistons and rods?"

"That's handled on the other side. There is no problem with standard or oversized pistons but sometimes we have to get into semi-finished types. Then we use the piston grinder to size them to the job. We can do cylindrical or cam grinding. Also, we have a knurling machine but it's mostly for gasoline engine pistons.

"We use a comparison-type pin fitter to get the right fit in rod bushings. We can get any fit that we want even

Heavy duty valve refacer not only handles valves with stems up to 15/16-in dia and heads to 4½-in dia, but has separate wheel and stand for surface grinding bearing caps, rocker arm noses, etc. Bearing cap is seen being ground.



Eccentric-type seat grinder finishing a valve seat. Below, a dial indicator mounted on the pilot used in grinding the valve seat, rides the valve seat in order to check for runout.

if there is a difference in a set of pins. The center-to-center distance can be set right on the head, too. Big-end bores can be trued on this machine but we use another machine. It is an eccentric grinder built just for this job. By facing off the caps, torquing them on and grinding, we get perfect holes."

"What about this facing of caps? How do you do it?"

"We do it on a heavy-duty valve refacer. It has a separate wheel and support for face grinding so that we are sure to get the faces square. If you know the amount of 'out-of-round', you take off a few thousandths more so that you can grind the bore to proper size."

"What about your valve operation?"

"Well, standard procedures call for automatic replacement of valves, springs, and guides. Occasionally we get a job where the customer wants to save as many of these parts as possible but we don't like it or encourage it. Seat inserts are replaced if they are getting to the point where they can't take the initial loss or where valves are dropping in too far.

"Our practice is to grind seats to the proper width and concentric with the axis of the guide bore. We check runout carefully and hold it to a thousandth or less. Seat angle is always matched exactly to the valve face angle. We don't like the ring seal you get with interference angles. Done our way, you get full seat-width sealing right from the start. Valves are lightly lapped on their seat and then given a hydrostatic test to check tightness."

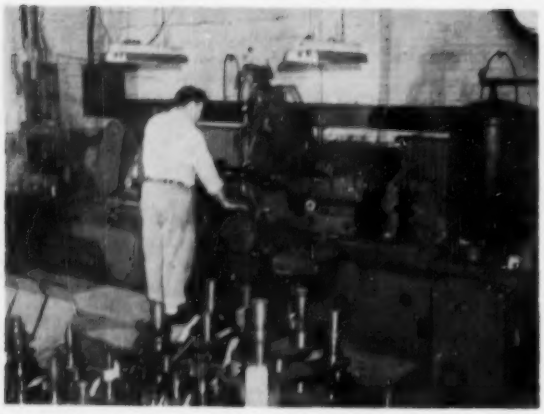
Surface grinding a head. Average-sized blocks can also be accommodated. For larger blocks, a larger-capacity machine is available.

"You spoke about face-grinding the heads and earlier mentioned block grinding. What about this?"

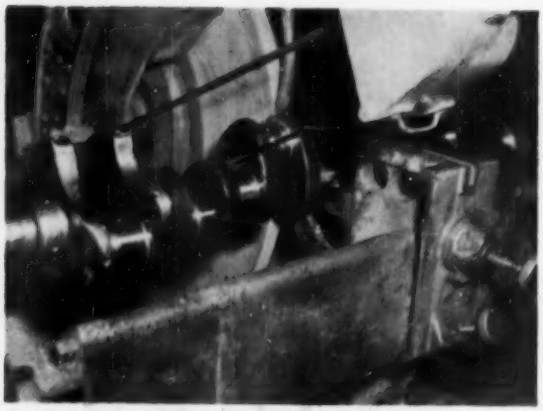
"Holding diesel pressures means that head-to-block sealing must be just about perfect. If you fill the humps and hollows by pulling down on the head, you are asking for trouble. We grind all heads on a machine with the wheel underneath. Big blocks—we can handle them up to 34-in high and about 8-ft long—are ground on a converted planer. We mounted a grinding head on the overhead tool slide and rigged the controls for this operation."

"It's obvious that you do a lot of crankshaft grinding. What is your setup?"

"We grind a lot of shafts, both for our rebuilt engines and on contract jobs. The smaller grinder does most of the work but when you get a big shaft, what can you do? For our work and outside jobs, we got the big one—one of the biggest around. It will handle railroad shafts, even the big Baldwins. With the raising blocks, the machine handles up to a 48-in swing and 15-ft lengths.



The smaller of two crankshaft grinders handles shafts up to 24-in swing and 84-in length. The journals are polished after grinding.



A high speed mildly-abrasive belt, an attachment available for these grinders, gives newly-ground journal highly polished finish.

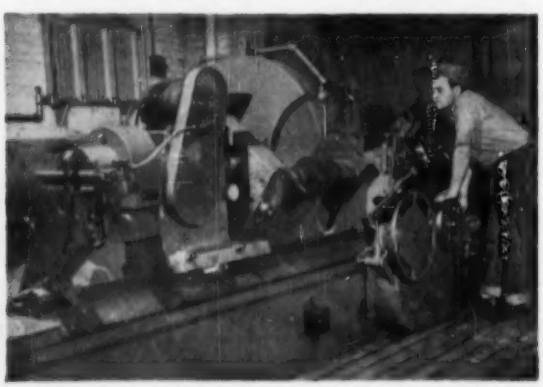
"As far as the grinding goes, it's all in the care you take with details. We check shafts out with the magnaflux machine before and after grinding. Incidently, rods are checked this way too.

"Shaft centering is important. We allow no runout at the timing gear end and only a thousandth at the flywheel end. Recentering is done if necessary. Then you can get cleanup at the maximum standard undersize. Get your indexing right, watch the fillets carefully, size properly, and you have a good, straight and true shaft.

"By the way, the Arnold gauges on the grinders are the only way to check a shaft. You can make a shaft on the bench and check out a journal round and straight. But you've got no guarantee that it aligns with the others. With proper centering and the Arnold gauge, we know that they are right.

"As a final step, all shaft journals are polished with an attachment on the grinder. With this rig, a very fine abrasive belt (400-grit), traveling at high speed, polishes the journals. Metal removal is about 0.0005-in and we allow for it in grinding. Of course, we clean oil passages and fair in the oil holes in the journals."

Large crankshafts with up to a 48-in swing and 15-ft length can be handled in this grinder, one of the largest in the area.



"What about other components?"

"They are all taken down on the bench, cleaned and inspected. All worn parts, gaskets, seals, etc., are replaced. All the machine shop facilities are available for this work. In fact we have some special tools. For example, we have the grinders for refinishing all flywheels."

"Now what about assembly?"

"The assembler gets all the parts and materials necessary to build up the engine. It's the parts man's job to see that he gets them. On time too. He builds up the whole engine and follows it right through final testing and run-in."

"Where do you get your data on clearances, torques, etc.?"

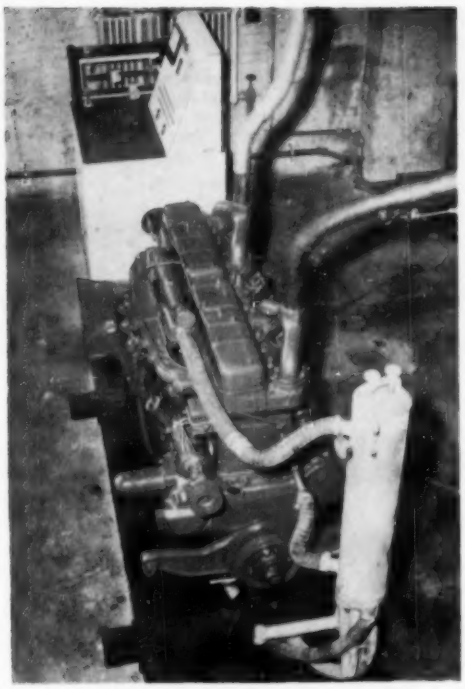
"Some we have gotten from manufacturers but we've had to piece out a lot of it. We have most of the dope but we could sure use a good manual like we have for gasoline engines."

"What about parts?"

"They're tough in a lot of cases. Some engine builders won't give us a reasonable price break and some—at least their distributors—make it hard for us to get factory parts at any price. Being somewhat in the parts business ourselves, we can get a lot of good, reputable replacement parts. Some of the parts are made by the same people that supply the factory."

"What is your policy on such things as bearing shells, oil seals and gaskets?"

"They're all replaced in any rebuilt engine. Take bearings. We won't take a job if a customer wants us to reuse them. It doesn't make sense. These engines are rebuilt to stay on the job. Some life is gone from even reusable bearings and the labor cost of early replacement is a lot more than the cost of a set of shells. That goes for seals and gaskets too."



Each engine rebuilt is tested and run-in on this dynamometer. Mounting adapters and system connections were tailored to accomodate a broad variety of engines.

"I see your dynamometer right by the front door."
"Yes, thats the last stop before engines are delivered. We test all engines. That means that the rings have seated and they are ready to go to work. I don't know how we got along before we got the rig. We can catch leaks, make all adjustments, power-test, and know that the engine is right before it leaves. No worrying about expensive comebacks.

"We bought mounting adapters and then reworked them to fit all the engines we test and to speed up mounting time. The rig will handle all engines up to 500 horsepower."

"Isn't testing pretty noisy right here in the shop?"
"Well, we spoke about the space problem before and actually we didn't have much choice in location, or room to build an enclosure. Anyhow, it isn't too bad. The exhaust noise has been quieted down by that big Maxim silencer near the roof. It would be nice to have a test cell but the noise isn't bad and being open makes engine handling easy."

"One final question. How many men do you have and how many engines, total and diesels, are turned out per month?"
"We average thirteen or fourteen men in all. Taking a yearly figure and breaking it down to months the average total is about 35 engines per month, with 6 to 8 diesels, plus extra jobs such as the crankshaft grinding."

"Thanks, Frank, and thank the others too. That's about it."

List of Major Tools

Cleaning Tanks	Aeroil Prod. Co., Inc.
Steam Cleaner	Clayton Mfg. Co.
Hones, Micromatic	J. S. Barnes Corp.
Pin Fitting Machine	Van Norman Co.
Rod Bore Grinder	Van Norman Co.
Line Boring Machine	Tobin-Arp Mfg. Co.
Piston Knurler	Wikening Mfg. Co.
Cylinder Head Grinder	Van Norman Co.
Valve Seat Grinders	Waterbury Div. of Vickers, Inc.
Valve Refacer	Van Norman Co.
Crankshaft Grinders	Van Norman Co.
Dynamometer	Clayton Mfg. Co.

What Do You Know!

Here are some questions to test your general knowledge of the diesel field. Make your selections, then turn to Page 64 to check them.

1. Master and link design of connecting rod gives vee-type engines certain advantages. Choose two of these advantages from the following:
   a. Lower unit bearing pressures.
   b. Higher torques.
   c. Shorter engine design.
   d. Smoother operation.

2. After a scored journal has been reground so that bench-checking with a micrometer shows it, as well as all other journals, to be round and straight, the crankshaft can be automatically considered true and be installed.
   a. True b. False

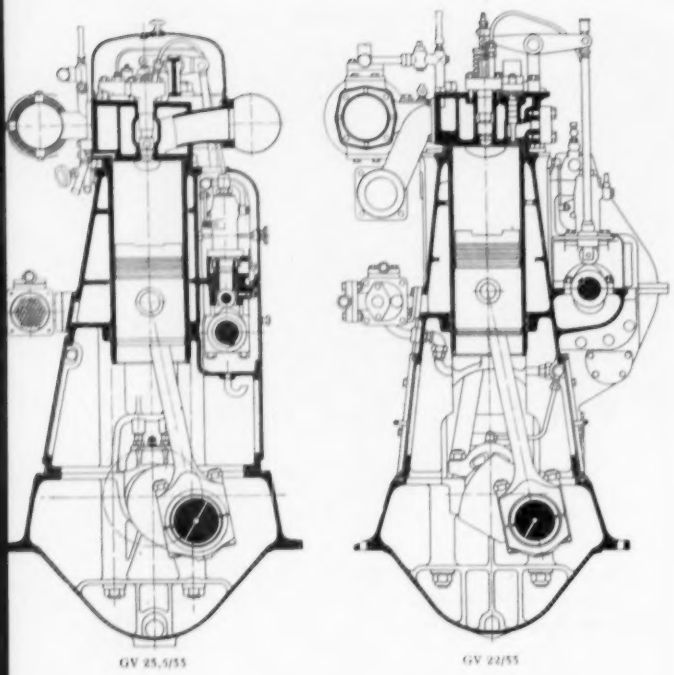
3. When rebuilding an engine, the most practical and economic practice with respect to the bearing shells is to:
   a. Replace regardless of condition.
   b. Reuse if not excessively worn.

4. When line boring bearing saddles, the bar should be:
   a. Centered to take equal cuts top and bottom.
   b. Offset to take most metal from cap.
   c. Offset to take most metal from saddle.

5. It is possible to use a standard transmission in conjunction with a torque converter.
   a. True b. False

6. As lube oil is heated above 200°F in temperature, for every 18°F increase in temperature, the rate of formation of oxidized oil products will increase about:
   a. 25% c. 75%
   b. 50% d. 100%

7. If an analysis shows that there is aluminum in a lube oil sample, it can come from which of the following:
   a. Pistons.
   b. Bearings.
   c. Bushings.
   d. Dirt drawn into the engine.



Comparison of the new 23.5/33 type with its forerunner, the 23/33. Engine is generally "tightened-up". Bedplate is reinforced, valve actuating mechanism is shortened and inclined, and crank webs are oval-turned, for simplified machining.

Highlighting M-A-N's "GV" Redesign

Some interesting ideas in design, leading to higher output.

FOR 30 years M-A-N's GV engines have had a successful career. Now they have been redesigned and improved to modern standards, and called the "A" series.

Included are three sizes of engines. Bore and stroke (in mm) are indicated by the two sets of numerals separated by the slant. These are the GV 23.5/33, the GV 30/45, and the GV 52/74. All feature increased rpm, higher horsepower, and in general a "tightening up" in design. Certain structural modifications have been made to tolerate the higher performance. Also, many components were redesigned.

In this respect, precision bearings are now used. The crankshaft is supported on steel shells lined with a bearing metal having a high lead content. The connecting rod bearings, however, which normally carry a higher load per square inch, embody a distinct departure from past M-A-N bearing practices.

These journal bearings are of tri-metallic construction. The third surface is not just an overlay coating; it is an actual running surface. The reasoning ran like this:

For optimum running qualities, a high-lead content white-metal is best. But a bearing of this type would have limited mechanical strength, unless supported. The support would have to be a shell of stronger material, such as steel.

It is well known that the thinner the white metal lining, the greater its load-sustaining capacity. On the other hand, a very thin lining is acceptable only if backed by a metal which, in the event of trouble with the lining, will afford the shaft protection from contact.

Sectional view of the tri-metallic precision bearing used on the journals of the 23.5/33 type. Inner layer is white metal, intermediate layer a soft lead-bronze, and flanged backing is steel.

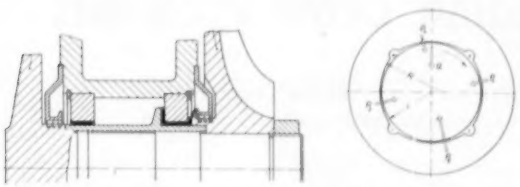
This metal could be brass; but steel shells have shown superior characteristics.

As a compromise, M-A-N selected a soft lead-bronze layer about 1 mm (0.040-in) thick as an intermediate layer. This makes a very good bond with the white metal.

What has happened is that the bearing offers low friction characteristics, high load carrying ability and good resistance to fatigue. Should trouble arise at the bearing the intermediate layer protects the shaft from damage. The steel outer shell gives strength. Every component is engineered to tolerate the increased output.

And speaking of higher output, M-A-N built turbochargers are now available for engines of 6, 7, and 8 cylinders. Built along the lines of conventional turbochargers, there is one noteworthy point in the M-A-N version. This is the use of a multi-surface plain bearing.

The contour of this bearing is not a true circle. It is a combination of four bearing surfaces, each of which has a slightly larger radius than the shaft journal. The rotation of the shaft within the bearing results in four oil "wedges" distributed over the circumferences. When under load, the shaft floats within the limits of radial clearance.



Longitudinal section and radial section through turbo rotor bearings. R is radius of bearing sections; r is shaft radius; and P1,2,3&4 are forces resulting from the four oil "wedges". Under load, these tend to force the shaft toward the center.

In this type bearing, the narrowest gaps will always remain in the same place. The forces acting on the shaft circumferences always tend to press the shaft into the center. Friction in the multi-surface bearing is claimed to be about 20 to 50% less than in a cylindrical plain bearing. Its lifetime is proportionately longer, according to M-A-N.

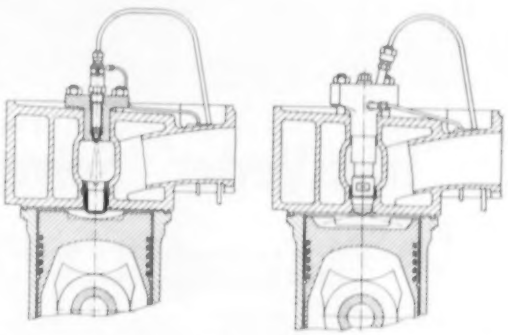
In accord with increasing the speed of the engines, M-A-N has reduced the reciprocating mass by using aluminum pistons. These also allow the engines, according to M-A-N, to develop higher bmep's. It is explained as follows:

Heat conductivity of the aluminum alloy is three times that of cast iron. This means, roughly, that the additional heat (resulting from the higher bmep) is dissipated more rapidly. In this way the new engine, using aluminum pistons, operates at the same cylinder temperature as the former—even though running at higher bmep.

Design wise, the new piston is vault-shaped. This offers extreme rigidity, which more than offsets the lesser mechanical strength of the lighter metal. It also provides the largest possible cross sectional area for the flow of heat to the rings and skirt from the crown. These pistons come in two separate versions, which leads into another design modification.

The same individual cylinder head is used whether the engine uses the open-type or pre-combustion system. As shown in drawing, a longer nozzle and holder assembly is used in the head for direct injection. The injector extends through the head opening so as to inject directly into the open combustion space. For the precombustion system, a much shorter nozzle assembly is used, leaving a portion of the head opening for a pre-combustion chamber. A separate piece fits the lower end of the cavity to form the chambers throat.

This single-head-for-two-systems facilitates production and gives the user a choice of combustion systems with only minor modification of the basic engine.

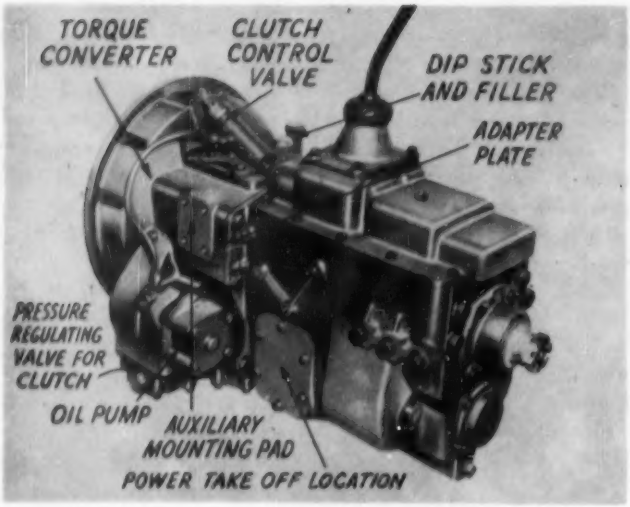


Pre-combustion system and open system both using the same head with minor modifications. Note differently shaped piston crown, nozzle and nozzle holder. Final compression temperature is same.

Choice has been given because of the relative advantages and disadvantages of each system. The narrow nozzle holes used with an open system make the engine more sensitive to inferior grades of fuel; but it uses slightly less of it. Pre-combustion systems are less sensitive to the quality of the fuel; but the water surrounding the pre-combustion chamber absorbs some of the heat. This system will use slightly more fuel; but it is quieter in operation with lower peak pressures. Sometimes, pre-combustion type engines are hard starting. M-A-N says that their engine using the pre-combustion system will start just as easily as the open-system version and explains as follows:

Remember those two piston versions we spoke about? Well, here is why. The crown of the piston used with the pre-combustion chamber engine is less dished out than that used with the open type system. This decreases the clearance volume. Compression ratio of the pre-combustion chamber engines is raised to such an extent that the final compression temperature is the same in either of the options.

Generally, modification of the GV engines has considerably expanded the M-A-N engine line. Redesign has brought it up to their standard of the latest engines. Experience gathered in the past few decades has been incorporated into the new engine series, and M-A-N feels certain that they will meet all requirements.



"TransVerter" is specifically designed for off-highway and stop-go operation. It's only eight inches longer than conventional transmisson and clutch. It can be installed without re-designing any standard make engine.

"TransVerter" Solves Some Drive Problems

Clark's combination of a torque converter and conventional transmission provides advantages of hydraulic devices for light off-highway units and stop-and-go service.

OPTIMUM methods of power transmission will largely depend on the cycle of operation of a particular vehicle or piece of equipment. Torque converters or fluid couplings, alone or in combination with various types of transmissions, have proved their value time and time again. But there is no one best setup for all applications; it depends on the operating cycle and—as always—costs.

By clever arrangement of drive components, the range of application is continually being broadened to provide the advantages of hydraulic devices in different services. Clark Equipment Co. has done this with their TransVerter unit for light off-highway units and for stop-and-go service. This power train package, is made up of a torque converter, hydraulic disconnect clutch and standard transmission. It's rated for engine torque output up to 325-lb ft.

Being only eight inches longer than a conventional transmission and clutch, this new unit can be installed without major re-design of engines or truck chassis. The TransVerter comes in one unit ready for mounting with any standard make diesel or gasoline engine.

Operational advantages of the new power train include elimination of engine stalling and lugging. Another feature is reduction in gear shifting to the point where most work can be done in the same gear. Fine inching control by simply working the throttle is another advantage. Still another feature is the provision for SAE power-take-off attachments to be driven by the torque converter. These features in addition to others make this power train particularly suitable for busses, garbage trucks, delivery trucks and various types of construction equipment.

Use of a hydraulic disconnect rather than a heavy friction clutch eliminates "tired left foot" troubles. It is an on-off type unit that doesn't require "letting in" or "easing". As a result, a variety of clutch releases can be used including a shift lever button or even a pedal raised slightly from the floorboard.

Now that we've discussed the important features and applications of this new power train, let's go over the construction and operation of its components.

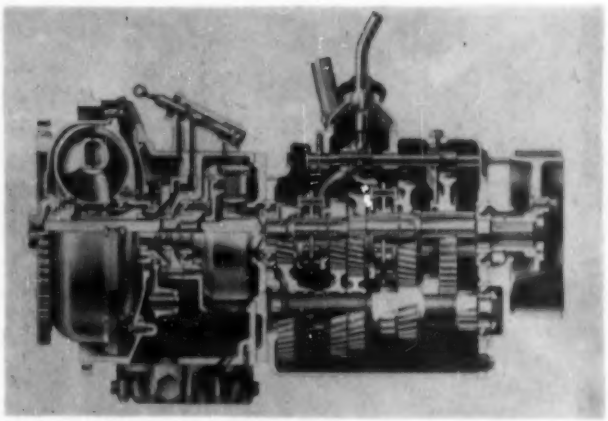
Torque Converter

The Clark designed-and-built torque converter in the TransVerter is a single stage, 3-element type with a 2.57-1 maximum torque multiplication ratio. It is equipped with an over-running clutch in the stator so that it performs as a hydraulic coupling under light load conditions. Because of this, the unit can operate at high efficiency throughout the load range.

All converter elements are single-piece aluminum castings mounted on high-capacity anti-friction bearings. Sufficient cooling capacity is provided so that the unit will not overheat even under severe loading.

The torque converter rotates in a dry housing rather than in a housing containing oil. This avoids oil leak problems at the flywheel housing. Maximum road clearance is made possible by having the bottom of the torque converter almost even with bottom of transmission.

The torque converter has a coupling-gear type of



Single-stage, 3-element torque converter in "TransVerter" has a 2.57-1 maximum torque multiplication and rated for engine torque output up to 325-lb ft. It rotates in dry housing. Disconnect clutch is hydraulically-actuated, of the multiple-disc type. Standard transmission is used.

drive. This permits the TransVerter to be fitted to any engine equipped with SAE housings and a suitable flywheel. Another flexibility factor is the adapter plate which joins the torque converter housing to the transmission case. This permits the torque converter to be used with a variety of Clark transmissions without having to change the converter housing.

Ordinarily the TransVerter can be supported by the engine flywheel since it is a compact unit. However, auxiliary mounting pads are cast into the converter housing to permit additional support if necessary.

Hydraulic Disconnect Clutch

The TransVerter disconnect clutch is a hydraulically-actuated clutch of the multiple-disc type. When hydraulic pressure is applied to the clutch, a piston forces the two sets of plates together. This couples the torque converter output shaft to the main drive gear of the transmission. Torque is then transmitted from the engine through the converter to the transmission and finally out to the drive shaft. When hydraulic pressure is released the clutch plates separate, immediately disconnecting the engine drive from the transmission so that gear shifting is easy.

Hydraulic pressure to the disconnect clutch is controlled by means of the clutch control valve—a simple hydraulically balanced spool-type valve. It is mounted on top of the torque converter housing for accessibility and easy maintenance. When the valve is "on", oil pressure is applied to the clutch pack. When the valve is "off", oil drains back rapidly to the torque converter sump so that the connect-disconnect action is quick and positive without "creep".

The clutch can be engaged at idling speed because the TransVerter is equipped with a torque converter. Slippage takes place in the converter rather than in the clutch. It is said to have an almost indefinite life since it is not a power absorbing member.

In normal operations, a TransVerter-equipped unit could be started in second gear. Third and fifth would be the other commonly used ranges. Once the working speed is selected, the transmission might be left in that gear for the whole operation. Low (first) gear would be needed for emergency torque requirements, creeping, etc.

Hydraulic Circuit

An oil circuit completely separate from the transmission is provided for the torque converter and hydraulic disconnect clutch. Installation of the TransVerter is thereby greatly simplified. There are only two connections for the entire hydraulic circuit, one oil line to the cooler and one oil line from the cooler.

An externally mounted oil pump provides hydraulic pressure for the converter and disconnect clutch. It is driven directly by a gear train from the input side of the torque converter. Since the torque converter is tied to the flywheel, the hydraulic pump is in operation whenever the engine is turning over. This means that there is hydraulic pressure even with the engine idling. An easily removable oil sump and screen serve the converter and the clutch. The oil pump itself can be detached for servicing by simply removing four bolts.

Two pressure regulating valves, one for the converter and one for the clutch, are located at the bottom of the sump housing. Either valve is readily accessible for servicing by merely removing a plug—and without disturbing anything else.

The entire hydraulic circuit uses only four gallons of Type "A" hydraulic fluid.

Model Availability

TransVerter power trains are available in the following types: 4 speeds forward—one reverse, or 4 speeds forward—4 speeds reverse; 5 speeds forward—one reverse, or 5 speeds forward—5 speeds reverse with 2nd, 3rd, 4th and 5th speeds synchronized; 5 speeds forward and one reverse in a non-synchronized version. All are available with SAE No. 3 Bell housing.

A variety of clutch and transmission controls as well as transmission brakes are optional equipment.

Lube oil analyses headquarters. Two record cards for each engine are kept in rotary file in foreground. One card carries record of analyses, the other has record of dates samples are taken. Cards come up as file is rotated showing serial numbers of engines from which oil samples are to be taken.

Laboratory Tests Cut Diesel Downtime

A review of actual testing and analyses in Pennsylvania Railroad laboratories, of diesels, their components, their fuels and lube oils, shows how potential or actual troubles are discovered. Reported results enable maintenance men to take early corrective action.

LABORATORY analyses and tests tell a lot about diesel engines, their components, and the fuel and lube oils used. Results of these tests and analyses are essential to maintenance departments. They show undesirable conditions, old or new, enabling maintenance personnel to take corrective action. This prevents many potential failures which would cause expensive and lengthy engine downtime.

Recognizing the benefits of tests and analyses, users with many diesels to maintain often have laboratories whose specific function is to make tests and correlate all data. Then they advise the repair and maintenance men of their findings and make recommendations.

An example of the type of test laboratories set up and the duties performed by them are covered in a paper recently presented by M. A. Pinney, Engineer of Tests, The Pennsylvania Railroad. Mr. Pinney spoke before the New England Railroad Club. He discussed in detail the problems which diesel locomotives bring into the PRR's test department. This article deals specifically with information and data in Mr. Pinney's paper which covers actual tests made by the PRR laboratories.

The PRR maintains one of the largest forces and facilities engaged in mechanical test, research and development work of any railroad in the U. S.

Their work comprises material inspection, fuel inspection, road testing, chemical and physical laboratory analyses, and lumber inspection. They also do research work of a varied nature along many related lines. Of the above, fuel inspection, chemical and physical laboratory activities, and road testing have been most affected by the diesel locomotive.

Fuel Inspection

Since 1949 the PRR has been purchasing No. 2 home heating fuels from a list of approved suppliers. The road has no specification for fuel oil. The only requirement is that it be of a quality equal to that of the sample submitted when the oil producer was placed on the approved list. This of course was dependent on that sample satisfactorily passing a laboratory analysis.

The major function of the fuel inspection department therefore, is to keep a check on fuel quality supplied the railroad. Also to inspect fuel oil storage and dispensing facilities to see that they are properly maintained and the oil kept free from excessive dirt and water.

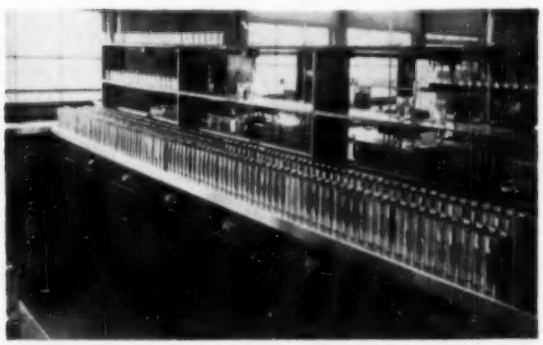
Heating fuels cost about one-half cent per gallon less than the 50-cetane fuels required by many railroads. Use of these fuels has saved the PRR more than $1,000,000 per year for the last six years, as compared with

what the 50-cetane fuel would have cost. More recently the so-called "economy grade" fuels—40-cetane, 1.0% sulphur—have been used at a further saving of about $670,000 per year.

Chemical Laboratory Work

About 60% of the 82,000 man-hours worked annually by the chemical laboratory is expanded on diesel work. This includes analysis of fuel and lube oils, analysis of oils from lube and fuel oil filter tests, training viscosimeter operators for enginehouses, checking cooling water treatment, analyzing and testing various cleaners and detergents for cleaning parts of diesel locomotives, and chemical analyses in connection with failed parts removed from diesel locomotives

Analyses of crankcase samples of lube oils, including "spectrographic analysis", is by far the most important part of the work presently performed in this laboratory. It is part of a program designed to prolong life of parts through a reduction of wear rates.



Lube oil samples taken from engines in the field are lined up ready for laboratory analysis. About 125-135 are analyzed daily.

Three major functions of heavy-duty lube oil used in road locomotive diesel engines, and the laboratory tests made to insure its satisfactory performance are as follows.

1. *Lubrication of rubbing parts* without wear and no overheating, and maximum efficiency in sealing between piston and liner to prevent blowby, are essential.

Dilution of lube oil with fuel oil or water rob the oil of its proper lubricating properties. To detect fuel dilution, a check of lube oil viscosity and flash point are made. If viscosity is less than 650 seconds, or flash point less than 360°F, oil is no longer considered satisfactory.

A check of the oil is also made to visually determine whether any free water exists in it. In the "spectrograph" analysis, a check is also made for boron, a (constituent of cooling water treatment). If boron is above a certain level content, cooling water has been leaking into the lube oil even though no free water is found in the oil sample.

2. *Cooling of pistons* and other parts is also accomplished by lube oil if it is properly cooled in lube oil coolers and is supplied in sufficient amounts. However, if lube oil is not being properly cooled, or is being circulated in inadequate quantities, it will become overheated. This overheating leaves its mark on the oil.

Lube oil used by the PRR should operate at about 185°F to 195°F. It contains oxidation inhibitors which prevent serious oxidation of the oil if these temperatures are not exceeded. If an oil cooler is dirty or is being bypassed, these temperatures will be exceeded.

For every increment of 17°F to 18°F at which the oil operates above normal temperature, oxidation rate will be doubled. For example, if an oil operates at 35°F above normal temperature, the first 17 to 18 degrees increment of this excess temperature will double oxidation rate. The second such increment rise will double it again making the oxidation rate four times what it normally would be.

Oxidation products in lube oil cause lacquer on pistons and in ring grooves. Since such deposits are acidic in nature they combine with water in the oil (from cooling water leaks or condensation) to form strong acids. These acids attack all parts of the engine which they contact.

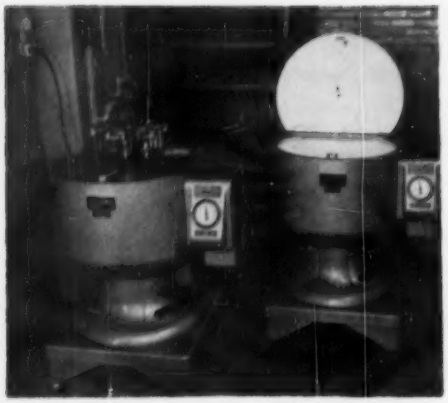
3. *Keeping clean interior of engine*, particularly the prevention of lacquer and carbon deposits on pistons and in ring grooves, and of sludge deposits in oil ports and passages, is the third major function of heavy-duty lube oil.

These cleaning operations are performed by lube oil because it contains metallic soap detergent-dispersive additives. These additives have properties which disperse oxidized oil products, dirt, carbon, etc. and hold them in suspension in the oil preventing them from depositing on engine parts.

Effectiveness of additives in dispersing these fine particles is gradually lost. Loss of additive effectiveness is one of the principal reasons for the presently established oil change periods for all diesel units on the PRR. New straight mineral oil has practically no ash content if a sample is completely burned at about 1000°F. Additive or heavy-duty type oil will leave an ash residue when so burned. Consequently, as a laboratory test, ash content of an oil sample is determined and used as a measure of the amount of additive remaining in oil.

Laboratory Procedures

Oxidation products determination consists of diluting a lube oil sample twice with normal pentane in a ratio of 9 parts pentane to 1 part lube oil sample. Each dilution of sample with pentane is centrifuged, the dissolved oil poured off and the centrifuge tube dried, leaving only those materials (dirt and oxidized oil) which are insoluble in pentane.



These centrifuges are used for separating dirt and oxidized oil in pentane and benzine insolubles tests.

If this residue is greater than 1% of the original sample, another sample of the same oil is twice diluted with benzene and centrifuged after each dilution. The dissolved products are poured off and the tube dried. Benzene dissolves both oil and oxidation products so that the insoluble left consists only of dirt. Subtracting the benzene insolubles from the pentane insolubles gives the amount of oxidized oil. If either dirt or oxidized oil exceeds ½% of the original oil sample, it is recommend-

Carefully weighed lube oil samples are put in centrifuge tubes. Two balances shown are used to weigh first empty tube, then tube plus insolubles. Electrically-operated balances are very accurate.

ed that oil be changed and that necessary work be done on the locomotive unit to prevent further contamination of new oil.

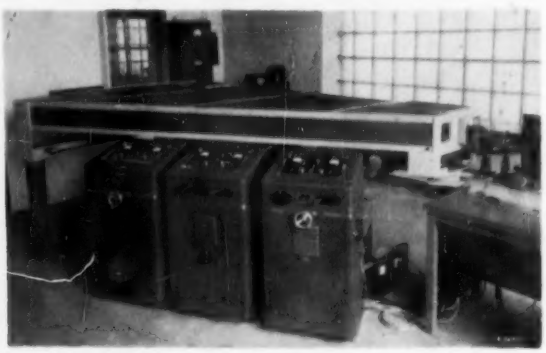
Viscosity is determined in the larger enginehouses by standard Saybolt viscosimeters. However, this type of instrument is too slow for production work where processing a large number of samples is involved. In the main laboratory, kinematic viscosimeters which can handle a large number of samples are used.

Flash point tests are made under a ventilated hood using a standard brass cup filled to a scribed line with a sample of lube oil. With a thermometer suspended in the oil, it is heated by an electric heater at about 10°F per minute. At each 5°F rise in temperature, a small gas flame is passed horizontally across the cup. The temperature at which a flash appears at any point on surface of the oil is the flash point of the oil.

Spectrographic examination is the next step in the oil analysis. It is made to determine the amount of wear metals in lube oil. This data assists engine maintenance to a considerable extent.

A two-gram sample of oil is accurately weighed into a small porcelain crucible. To this is added 600-mg of chemically pure graphite. The crucible is then placed on a hot plate (under a hood) and thermostatically maintained at about 700°F.

After the oil has cooked so that only a dry coke remains (usually 5 to 6 hours), the crucible is placed in a muffle furnace where the coke is heated at 1000°F for one hour. Then the crucible is removed and allowed to cool, after which 60-mg of lithium carbonate are added. After the coke and lithium carbonate are thoroughly mixed in a wigglebug machine, a hollow-cup-bottom electrode is filled with a sample of the mixture and sent to the spectrograph. (See DIESEL POWER, May, 1953 for a brief description of a spectrograph, and its use as a maintenance tool).



Spectrograph makes photographic record of wear metals and other elements in lube oil. At right are electrodes for striking arc, the slit and lenses for admitting light into body of instrument.

From the photographic record made with the spectrograph, the amount of wear metals and other elements in the oil are seen by use of a densitometer. In this instrument a beam of light is passed through the spectrum lines appearing on the developed photographic plate. Line density is measured by noting the deflection produced on a galvanometer by voltage generated in a photoelectric cell by light passed through the spectrum line.

Since variation in the flickering arc intensity can produce variations in spectrum line density for the same quantity of element present in the sample, an internal standard of exact amount (lithium carbonate-60 mg.) is added to the sample before it is burned. Any variation in spectrum line intensity due to arc variations will

Photographic record made with spectrograph is placed on this densimeter which by measuring and comparing the line density of wear metals to line density of lithium carbonate (an internal standard) shows the amount (ppm) of the wear element present in the oil.

affect the lithium lines in the spectrum to the same degree that wear elements lines will be affected.

Thus, by simple calculation of the ratio of wear element density to the line density produced by the known amount of lithium added, the amount (ppm) of the wear element can be determined. A calculating board is used for quick determination of the amount of wear element present without going through a mathematical calculation for each element in the sample.

Eight elements (wear metals) are determined by this spectrograph analysis. (1) *Silver* can come only from silver plated wrist pin bushings. (2) *Aluminum* may come from road dirt drawn into any engine with combustion air. But it most likely comes from aluminum pistons. (3) *Chromium* comes from chrome plated liners (or from cooling water leaks when chromate treatment is used). (4) *Copper* and (5) *lead* may come from a number of parts, such as brass bushings, camshaft bearings, etc. But most likely these come from main and connecting rod bearings, and camshaft bearings.

High copper without presence of high lead usually means wear on brass or bronze bushings or thrust bearings. High lead in the absence of high copper indicates excessive wear rates on lead overlay of crankshaft bearings. Presence of both high copper and high lead is indicative of trouble with the copper lead bearing metal in crankshaft bearings.

(6) Iron can come from plain iron liners, iron pistons, piston rings, gears, and crankshafts. (7) High *silicon* is usually an indication of road dirt getting into engine with combustion air due to inadequate air filtration. It also indicates a probable lack of proper air filter maintenance. (8) A content of *boron*, which

No. 1-A 1954 ENOLA

D-E LOCO. LUB. RECORD Eng. Ser. No. 6053 Class EF15A

Date sampled	6-21	7-7	7-19	8-18	8-19
Lab. No.	4038	4807	5317	6565	7470
Oil last changed	6-5	7-1	7-1	7-19	7-19
Reason for change	Dilution	Ltr 6-25	Ltr 6-25	Ltr 7-14	Ltr 7-14
Mi. since oil change	18821	19240	19972	20030	14997
Filters last changed	6-6	7-1	7-7	7-19	8-8
Mi. since filter change	4790	1840	1152	6958	4694
Last monthly inspec'n	5-20	6-21	6-21	7-19	7-19
Flash	470	440	460	455	435
Vis. at 100° F.	938	936	915	944	910
Pentane Insoluble	.21	1.57	.25	.31	.41
Oxidized oil		1.38			
pH	8.5	8.3	6.9	8.1	8.7
Ash					
Ag	.95	.4	.6	.4	.4
Al	1	1	23	4	1
Cr	175	T	9	0	0
Cu	35	7	9	6	6
Fe	50	8	23	13	12
Pb	95	5	10	5	4
Si	1	T	10	3	0
B	1	7	7	3	0
EH Fore. notified	6-25	7-14			

Reproduction of typical record card shows results of spectrograph analyses of lube oil samples made on different dates. For example, results of 6/21 analysis shows high lead, high copper and high chromium content. (Chromate cooling water treatment used in engine.)

This calculating board quickly figures the amount (ppm) of each wear metal in sample by comparison of their line densities to line densities of known quantities of wear elements. This eliminates mathematical calculation of each of the wear elements.

is present in the non-chromate cooling water treatment used, shows that cooling water has leaked into lube oil, even if there is no free water present.

Based on the results of a spectrographic analysis, laboratory supervisors make a report to the maintenance foreman on a suitably designed form. This form shows the spectrographic results which indicate that certain parts of engine may be wearing excessively and suggests the corrective action to be taken. It then becomes the responsibility of the foreman and his force to locate and correct the trouble, or satisfy himself that no serious defects exist.

The report form also provides space for reporting

THE PENNSYLVANIA RAILROAD
EXAMINATION OF DIESEL CRANKCASE OIL

Altoona, Pa., 6-25-54

C. A. Minster (5) Unit No. 9801A Class FT54

Foreman, Diesel Shop, Enola Engine No. - Sampled 6-21-54

Items checked are in excess of significant values:

Condition of Oil			Spectrographic							
Dirty	Oxidized	Fuel Dilution	Lead	Copper	Iron	Chromium	Silicon	Aluminum	Boron	Others
			X	X		X				

Above conditions are indicative of high rate of wear of main and/or connecting rod bearings or thrust bearings and cooling water leaking into lube oil system.

Unless already done since sampling date, perform work items checked below:

(a) by shopping unit promptly , or (b) at next shopping of this unit X

Clean		Change		Inspect							
Engine Air Filters and Air Box	Flush Lube Oil System	Lube Oil	Lube Oil Filters	Main and Conn. Rod Bearings	Camshaft Bearings	Thrust Bearings	Pistons and/or Liners for Wear	For Fuel Oil Dilution	For Water Leaks	For Improper By-Pass in Oil Filter System	Temp. Controls With Engine Under Full Load, for Any Excessive Lube Oil Temp.
	X	X	X	X		X			X		

Note:

Indicate below work done and defects found. Forward one copy to your GSMP or Works Manager through the regular channels and return one copy to the GSMP-D, Philadelphia, Pa., and the Engineer of Tests, Altoona, Pa.

cc: GSMP (2) J. S. Ball (1) M. A. PINNEY, Engineer of Tests

Works Mgr. GSMP GSMP-D Engr. of Tests

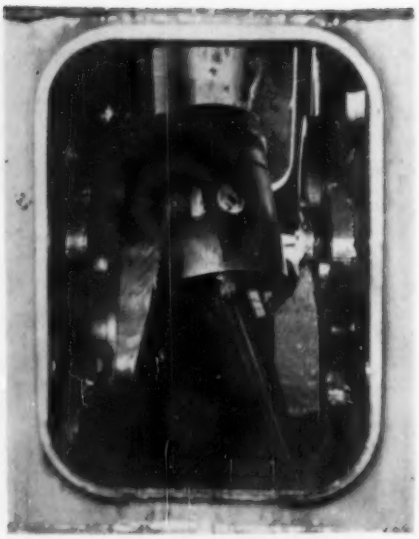
Work as follows to correct conditions reported above was done on 7-1-54. (Date)

Work done: Changed lube oil, flushed lube oil system, changed lube oil filters and engine air intake filters, water tested engine and inspected all bearings, renewed all upper con-rod bearings and 1, 2, 7, 8 lower con-rod bearings, renewed all main bearings, renewed #4 and #11 cylinder heads and seven exhaust manifold studs.

Defects found: Bearings worn, water leaks at cylinder heads and stack studs.

IF ADDITIONAL SPACE IS REQUIRED, USE REVERSE SIDE.

C. A. Minster Foreman
Enola Diesel Shop Enginehouse



Engine damages such as this have been greatly reduced through use of spectrograph analyses which show up unfavorable conditions in bearings, etc.

This typical laboratory report dated 6/25 advised the maintenance foreman of the findings appearing on the record card (shown on preceding page) and what these findings indicate. Bottom of form shows defects found by maintenance men and work they did on the engine.

oil conditions, *i.e.* dirty, oxidized, or fuel dilution, and corrective action necessary. This form is completed by the foreman to show the defects found and the work done to correct improper conditions. Copies of the completed report are sent to the Engineer of Tests and to other interested officials.

Engine inspection and actual examination of the suspected parts do not always disclose the defects anticipated, but the percentage of suspected defects found runs high. Many failures are prevented in this way, some of them being potential costly breakdowns.

Physical Laboratory

About 37% of the 59,000 man-hours worked annually by the physical laboratory are expended on diesel work. This includes investigation of failed diesel engine parts; development of methods for reclaiming worn diesel parts; supervision of ultrasonic testing of diesel axles and research in the use of reflectoscopes to test diesel locomotive wheels. Also included are supervision of magnaflux and magnaglo testing, including preparation of instructions covering apparatus and test techniques for diesel parts; testing packing and gaskets, hose, couplings and other diesel parts to develop acceptable additional sources of supply; acceptance tests of wire and cable and other diesel parts; and repairs to load meters.

Road Testing

A group working on road testing conducts all service trials of apparatus, devices and parts on equipment. This is to determine which manufacturer's parts give most satisfactory and economical operation. These men must know all new maintenance practices as well as the engineering, design and functioning of parts being tested, to arrive at the best conclusions. A correct interpretation of test results can mean large savings.

About 65% of the 72,000 man-hours worked annually in this department are expended on diesel work. This includes tests on durability, efficiency, etc., of such diesel parts as: lube and fuel oil filters; air intake filters—impingement vs rotonamic and oil bath; lube oil centrifuges vs standard filters; vee-belts and shock absorbers; injector nozzles of various steels; chrome vs plain iron liners; chrome-plated piston rings; lube oil coolers;

reclaimed parts such as armature shafts, pistons and crankshafts; main and connecting rod bearings other than builder's standard; and many other mechanical and electrical parts. Important also, are the service tests of lube oils, all of which are conducted by this group.

Currently over 100 such service tests are underway. A record of every roller bearing in service is maintained by this group to develop comparative performance of the various types. Examinations are made of each damaged diesel engine as it is dismantled to determine cause of failure.

This piston was sectioned in laboratory to find out how much carbon had been built-up in the heat dam. This is done to determine if piston is overheating.

Very few tests involve only one sub-department of the test organization. Most tests involve the efforts of two or more groups. Typical of these are tests on diesel engine lube oils.

Service tests of lube oils are closely followed by the road test group. But at each 5000 miles, a road test inspector sends an oil sample to the chemical laboratory for spectrographic analysis. At conclusion of test, crankshaft and pistons are sent to the physical laboratory for bearing micrographs to disclose whether there has been any bearing corrosion. Pistons are sectioned to determine the carbon build-up in the heat dam.

Recently a test was made to evaluate the performance of various air intake filters by use of radio-active piston rings. Five different kinds of filters were tested. Filters were evaluated by measuring the increase in radio-activity of lube oil after two round trips (2800-mi) in freight service between Enola (Hbg.) and Chicago. Each kind of filter was applied to the test engine. A dust sampler was also installed in the engine room to measure the dust lading of intake air to compensate for this factor.

Results of these filter tests were evaluated and the relative merit of each air filter was established. While this is not the first time radio-active parts have been used in locomotive diesel engine tests, it probably is the first time such work has been done by any U. S. railroad with its own forces.

This test was made under the direction of the PRR chief chemist, who several years previously had attended an AEC school at Oak Ridge, Tenn. Therefore the railroad had qualified personnel to supervise the test. They were also in a position to get favorable consideration when application was made to the AEC to have the rings activated and the test authorized.

During the entire test period of about two months, a test department inspector was assigned to the unit for 24 hours of every day. He made sure that no unauthorized personnel came near the engine and that the test was properly conducted.

Tests with this method were successful, and while using only one engine, tests were completed in two months. Under previous methods these tests would have taken at least 30 months' operation on each of five engines.

Summary—Savings Effected

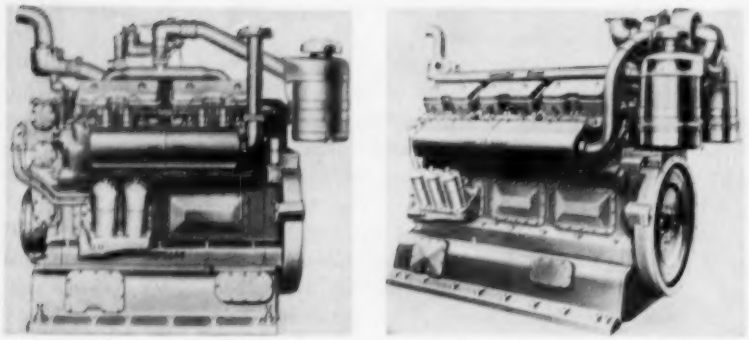
Savings attributed to results from spectrographic analyses of lube oil are impressive. About $1,610,000 is saved each year. This is obtained from three general improvements.

Repair cost records are maintained. A review of such costs prior to May 1, 1954, when spectrographic analysis was initiated, and similar costs for a 20-month period since that date, show a reduction of $585,000 annually. In addition, at least $500,000 a year have been saved through reduction in wear of parts by maintaining proper lube oil conditions.

When a unit comes due for shopping according to an established periodic schedule, it is placed on a due-list. Monthly thereafter, the maintenance shop and spectrographic laboratory forward reports to the chief mechanical officer outlining condition of the unit and engine. Recommendations are also made whether condition of unit is such that it can be safely continued in service. This has extended shopping periods and reduced down-time, thereby saving an additional $525,000 annually.

From a study made about two years ago of other test department activities, here are two other interesting ones. PRR inspectors rejected new material having a total value of over $2,500,000 annually. A large part of this material was reworked by the manufacturer and later accepted. If it had not been checked by inspectors, the faulty material would have been received and corrected by railroad forces at a considerable expense.

This study also showed that in 13 major projects alone, savings from work in which test department played a major role totaled $1,690,000 annually. This amount alone exceeds annual cost of operating test department.



Series "D" D375 and D397 with engine-mounted lube-oil filters

Cat Redesigns Two Industrial Engines

Design changes provide better breathing ability plus turbocharging. Series includes both oil and gas engines.

CATERPILLAR'S industrial engine line has been augmented by the addition of two heavy-duty vee-type engines. Up to a maximum of 650-hp can be produced by the larger engine, operating at 1300-rpm with turbocharger.

Comprising the new "Series D", the 8-cyl D375 and the 12-cyl D397 are available in turbocharged, roots-blown, naturally-aspirated and spark-ignited gas versions. Like their predecessors, D375 and D397, they are four-cycle design.

Principal differences from the former models are in the cylinder heads, exhaust manifolds, methods of supercharging, and concerning the spark-ignited engines, in the new "deep-domed pistons".

Many features of the earlier engines were retained, however, in the new models. They use the same completely water-jacketed cylinder liner and the same low-pressure, precombustion-chamber type fuel-injection system. A redesigned cylinder head allows more air into the engine, and gives better performance on the normally aspirated as well as the supercharged engines.

Turbochargers available for these engines enable them to produce increased power with less fuel by utilizing the energy of exhaust gases, which would normally be wasted. Greater output is due to combining the benefits of turbocharging with the increased ability of the engine to breathe. The new cylinder head provides a more direct route from the combustion chamber to the exhaust manifold. This enables the engine to take advantage of the extra air provided by the turbocharger.

Adding to the versatility of series D, exhaust manifolds are offered in "wet", "shielded" and "dry" versions. This is to aid users in adapting the engines to their specific needs. The new shielded manifold uses a heavy layer of fibreglass encased in steel. It keeps heat out of the engine room without adding to the cooling load of the engine.

Aiming at compactness, engines are equipped with a space-saving lubrication system. Engine-mounted filters are now standard. Large capacity, externally-filtered lubricating systems will still be available, but as attachments.

Two new spark ignited engines, D375 and D397, produce 267-hp and 400-hp respectively burning natural gas. Compression ratio is ten to one. Heavy-duty industrial type carburetors are used. Low-tension magneto ignition system and the new "deep-domed" pistons help give better engine operation.

The ignition system uses a magneto to feed low-tension current to high-tension transformers. These are located near the spark plugs. A hot, positive spark is produced by keeping the high-tension leads very short.

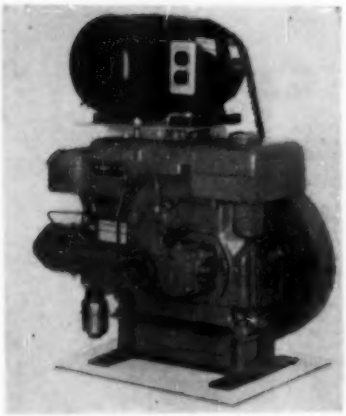
The "deep-domed" pistons are the result of extensive research and engineering. They are designed to give smooth, efficient combustion over the wide range of operating conditions for which the engine is intended.

The new engines are expected to find a wide variety of applications. They are well suited for powering pipeline pumping, sewage disposal plants, cotton gins, municipal pumping stations, and stationary irrigation systems. Operating economy might be a factor favoring the gas engine in areas where natural gas is available at lower prices.

A Caterpillar self regulated generator will be available for the new engines. Of compact design, it is close mounted to the engine. Designed for high efficiency with extreme simplicity of operation, it is adaptable to a wide range of engines and power outputs. These can be seen in chart.

Power Outputs—Engine and Electric Sets

	Industrial				Marine	
	Max. HP @1300 RPM	Inter. HP @1300 RPM	Cont. HP @1300 RPM	KW @1200 RPM	Inter. HP @1225 RPM	Cont. HP @1225 RPM
D 397						
Turbocharged	650	575	500	350	550	500
Roots blown	.....	520	450	315	500	450
Naturally aspir.	.....	415	360	250	.....	.....
Spark ignited	.....	.....	400	.....	.....	.....
D 375						
Turbocharged	430	375	325	225	300	300
Roots blown	.....	350	302	200	300	300
Naturally Aspir.	.....	275	238	165	265	235
Spark ignited	.....	.....	267	.....	.....	.....



An Unusual Generator Set

Compact and rugged, a new and modestly-priced generator set uses a diesel with interesting features.

A SMALL, compact, diesel generating set is now being marketed from the West Coast. The durability and operating economy of diesel (power for) sets in the 2 to 3-kw range has always been desirable; but original cost was the hurdle. Lynn Engineering Company has narrowed the spread between these and gasoline-powered sets.

The engine is an import—the Farymann Model E, 4-cycle single-cylinder unit coming from Germany. This 6-hp horizontal-type engine has a steel cable cog-type non-stretch vee-belt connecting it to the generator, which is mounted on top by four bolts.

The generator is the Leland military model, that meets all military specs. The 1800-rpm unit is self-excited, and tropicalized with fibre glass insulation. It's rated 2500-watt continuous; 3000-watt intermittant. Inherent voltage regulation is plus-or-minus 5%. Current is 115-v, 1-phase, 60-cycle at rated speed.

In addition to the generator drive, the engine has two standard power take-offs, broadening its application. Full rpm can be taken from the flywheel, and 2:1 reduction from the control shaft side.

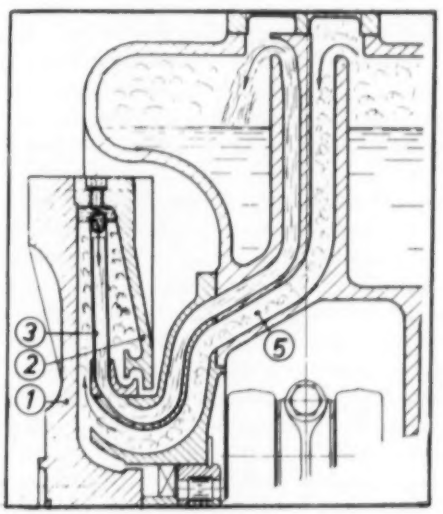
The engine is simple and ruggedly built. There are no sleeve bearings, all are roller or ball-type. The shaft is "built-up" to permit installation of the crankpin bearing. There is no oil pump, as the engine is splash lubricated.

Head is high-turbulence design with a pre-combustion chamber, and fuel quality (with limits) is said to have little effect upon performance. Robert Bosch supplies the fuel injection system. There are no cooling accessories, as the engine is fitted with evaporation cooling.

Remember those hopper-cooled engines? The cooling principle used is the same—but today it's called "high-temperature cooling". And like some of the later and more elaborate installations, the steam is condensed to avoid excessive water makeup. And it's simple.

Water passages around the wet-type liner and cylinder head are connected to a "hopper", a closed storage tank above the horizontal cylinder. As the water in the jackets reaches boiling temperature, steam forms. The water temperature never goes higher because the excess heat is removed during the change of state from water to steam (latent heat of vaporization phenomena).

Steam being formed expands through a tube (5) into



the recessed flywheel (1 & 2). Fins on the flywheel carry away the heat, and the steam condenses. The water then forms a ring around the periphery of the flywheel cavity, where it is centrifugally forced through another tube (3) back to the storage tank for another cycle.

There is an annular slit around the flywheel hub, which serves as a vent, preventing pressure rise.

This diesel generating set measures only 25-in by 20-in by 30-in high, and weighs only 315-lb. It is designed to give 3000-hr of service without overhaul; but some have given more. Inexpensive operation and dependability warrant the small premium required for diesel power.

Starting fluid capsule at right is placed into capsule chamber (with knurled cap) and punctured by pin attached to knurled knob (above knurled cap). Double-action pump at right (horizontal) forces mixture of fluid and air through tubing and nozzle.

Cold Starting Made Easier

Simple compact starting aid proves effective in sub-zero starting. Quick starts save time, reduce engine parts wear, lowers starting equipment load and lengthens lube oil change period by cutting dilution.

WHEN temperatures go way down, diesels may balk at starting. Naturally, any device that will preheat incoming air, inject an easily ignitable fluid, or actually provide a flame to ignite initial fuel charges, cuts these cold starting difficulties. These devices will then pay off handily.

Many methods are used to make cold starting easier. And of course, the simpler and more efficient the method, the more desirable it is. One device just introduced in this country after eight years of successful use in Europe is Start Pilot. This precision engineered starting device is being distributed here by the Start Pilot Corp. Their western representative is the Wilco Co. of Calif.

Starting fluid carburated with air, is injected into the intake manifold. This keeps the engine firing until regular fuel ignites and continues to burn. At 0°F the engine should start in three to five seconds. The device is designed to give quick starts even at temperatures as low as —70°F. Such quick starting, reduces engine wear and battery and starting equipment life is lengthened.

This compact unit has been successfully used on a variety of diesel powered equipment. One example is the application of this unit by Turner & Co. Ltd. of Glasgow, Scotland, on the Trans-Antarctic expedition ship, the M/V Theron.

According to a report in the English journal "The Oil Engine And Gas Turbine", three models of Dorman diesels using 24-v electric starters were successfully started at —15°F at 8000-ft and —25°F at sea level without auxiliary heating. Only Start Pilot was used.

The Model 956A Start Pilot can be used on engines up to 750-hp. For higher output engines the Model 956B is used.

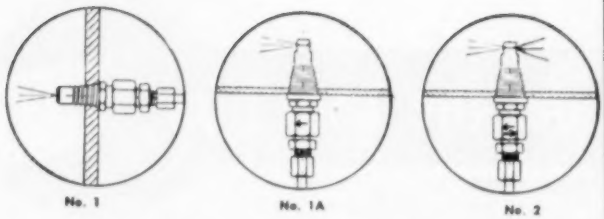
This self-contained dispensing unit is made up of a main unit having a capsule chamber and a hand-operated double-action air pump. A nozzle connected to the pump by copper tubing, screws into the intake manifold.

A special low ether-blend of starting fluid, packed in hermetically-sealed, ready-for-use capsules, is placed into the capsule chamber and manually pierced by means of a built-in pin. Fluid drains into a reservoir chamber. The pump draws fluid from this chamber through a metering jet into a second chamber where it is mixed with air and primary carburetion takes place. Then the double-action pump forces the mixture through the nozzle into the inlet manifold.

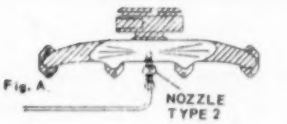
Three types of nozzles are available. The one with two opposed spray holes (shown in the illustration) is used for most installations. This is furnished unless otherwise specified. If the manifold is too long or if the engine has more than one manifold, multiple nozzles are used and connected in parallel. These nozzles must be placed for best possible distribution of starting fluid to all cylinders. Nozzle installations in inlet manifolds of various arrangements are seen in the accompanying illustration.

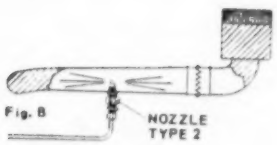
Quicker starts will be made if the nozzle is located near the intake valve ports. For supercharged engines, it may be fitted ahead of the supercharger.

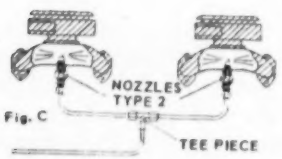
Usually the manifold has to be drilled and tapped to install the nozzle. However, other methods of installation are possible where special manifold problems exist.



Nozzles are made to spray directly forward, (No. 1), to one side, (No. 1A), or in opposite directions, (No. 2). The No. 2 nozzle with two opposed spray holes is suitable for most installations and is furnished unless one of the other two types is specified.







If intake manifold is too long or engine has more than one manifold, multiple nozzles are connected in parallel and in best location to distribute fluid to all cylinders.

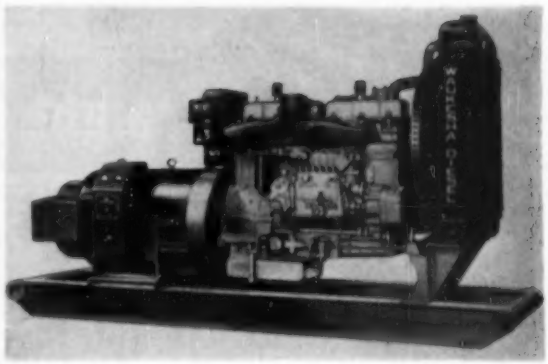
This nozzle has opposed spray holes. It can be screwed into intake manifold for mounting.

As for the pump unit, it is located as near as possible to the starter button on the dashboard or control panel.

With electric-started engines, the pump is manually operated at the same time that starter button is pressed. With air, inertia or hydraulic starters, the pump is hand-operated for two to three seconds before starting. Up to five starts can be obtained from each throw-away capsule under average cold starting conditions.

Since these capsules aren't affected by temperature or humidity they can be stored indefinitely. The fluid contains lubricating qualities said to protect liners and upper piston areas. A corrosion inhibitor neutralizes acid formation caused by sulphurous compounds of fuel mixing with condensed water during cold starts. Corrosion is further minimized due to the small amount of ether (11%) in the fluid.

Since carburetion takes place in a separate chamber, raw fluid never contacts the engine cylinders. This, plus elimination of excessive fuel injection during cold starting, reduces lube oil dilution.



Waukesha Enginators For Industrial Use

WAUKESHA'S new series of industrial engine-generator sets, just introduced, have capacities ranging from 50 to 600-kw. These complete power packages are known as Enginators. The generators on these units are driven by diesel, gas or gasoline engines depending on the application or customer preference.

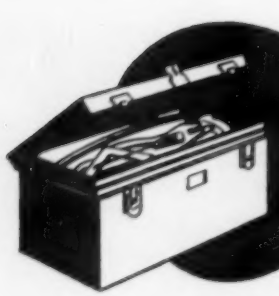
Waukesha Enginators, both propane and diesel, have been standard equipment on railroad passenger and dining cars for years. More recently, similar units have been used for powering refrigeration systems on railroad cars. Now Waukesha steps into another field and makes a complete package supplying electrical power for industrial use.

One example of the new series is the model "148-Diesel". This series is available with engines having continuous ratings ranging from 50 to 120-hp. Continuous k-w range of these units is from 50-120 depending on operating speed. Other capacity units are also available with generators of different synchronous speeds depending on whether the unit is for stand-by, intermittent, or continuous service.

Waukesha "148-Diesels" are made as a normal diesel with a standard crankshaft (148-DKU); as a normal diesel with a counterbalanced crankshaft (148-DKBU) or as a turbocharged diesel with a counterbalanced crankshaft (DKBSU).

Largest of the engine-generator power packages built by Waukesha is powered by the vee-type, 12-cyl, turbocharged diesel model VLRDBSU. It is rated at over 1100-hp for continuous duty.

Numerous Waukesha engines of all sizes have been used in generator sets made by independent builders. But these industrial Enginators, built as complete electric power packages by Waukesha, are a new source of electric power for increasing demands of modern industry.



Straight from the Tool Box

This is YOUR Department. Pass along your ideas to the other fellow. Send items to the Editor, preferably with a picture or sketch. Contributors will receive $10.00 for each item upon publication.

Detecting Chrome Liner Wear

Gerard Sutherland, Pittsburgh, Pa.—Our shop works on a lot of engines that have chrome plated liners. The layer is usually from .020 to .025-in thick in diameter, and though it gives up to three or four times the life of an iron liner it wears through sooner or later.

When we take one of these engines down, it's hard to tell whether the chrome has worn off, because the liner surface is usually smooth and glazed.

To make sure, we soak a clean rag in copper-sulphate solution. Then we wipe the rag over the liner, paying special attention to the area of most wear (top of ring travel). If the iron is through the chrome, the solution that contacts it will turn a sort of brownish color.

This is a sure way to tell without guess work.

A good method that should give a true report.—Editor.

Tools from Other Trades

E. F. Boyack, Ft. Lauderdale, Florida—Sometimes it will take a long time to do a little job because you need a special tool. Sometimes a tool that is made to do something else will make your job easier.

I found that one of those selective wheel-type hand punches is a handy tool to keep around. It is a time saver when working on small engine components. It cuts clean, accurate holes in all types of gasket material and light shim stock.

These wheel punches come in a couple of sizes, from 3/32 to 3/16-in, and from 5/32 to ¼-in. Each wheel has six different size holes.

I believe there are many other tools and gadgets used by other crafts and trades that can be adapted to make repair jobs easier and faster for diesel men, if we keep an eye peeled for them.

A sound suggestion. A great number of tools are multi-purpose in application, if not name. Usually, a little observation will pick out at least an additional use.—Editor.

Shimming a Pressed-On Gear

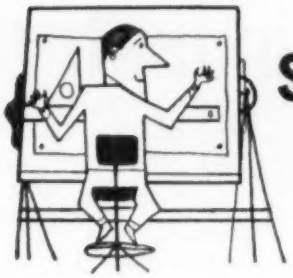
Frank Bevaqua, Fairview, New Jersey—There are a lot of places on different engines where shims are used to control clearances. Sometimes these shims are located behind a pressed-on gear. When you have to fit shims behind one of these gears, you'll be lucky if you don't miss on the first try. If you do, you'll have to pull the gear, change the shims, and press it back on again. This takes a lot of time, and is hard on the shaft.

Continental HD260's are an example. Crankshaft endplay is set in this manner. I have found a simple way to cut the time and improve the accuracy on this adjustment (I got sick of pulling and pressing the timing gear).

Take an old gear and grind the center hole 0.005 to 0.010-in oversize, so that it slips freely on the shaft. To check shaft endplay, all you have to do is lock the gear in place. If you don't hit the right adjustment the first time, it is easy to take the gear off and change the shims.

Once the shims are right, you press on the good gear and you're all set. Changing an old part and using it as a spacer really saves you time. After a while, you get to look for similar jobs where you can use the same idea.

You are right. Manufacturing tolerances of parts are generally close enough so that the resulting adjustments will fall within specified limits. Incidentally, this principle can be applied when "timing" blower rotors. We ran an article on this some years ago.—Editor.



service section

Recent engine and equipment modifications, procedures and recommendations straight from the different manufacturers to you

Caterpillar Precision Bushings

Precision replacement bushings are now offered for both bushings in the rear accessory drive housing of D397, D386, D375 and D364 Engines. Field replacement of the bushings can be done quickly, with a minimum amount of downtime. The service department is equipped with precision tools to accurately install the new bushings in your engine.

EMD Says Flaking Of V.P.I. Inhibiting Material Not Detrimental To Parts

One of EMD's customers recently raised a question concerning the flaking of the inhibiting material on V.P.I. paper. It appears to have powdered off the paper and deposited on the parts inside the wrapping.

Electro-Motive purchases the paper from several vendors, each of whom bonds the material to the paper differently. Some are loosely bonded, and others tightly.

The loose bond will, naturally, tend to flake more, but this is not detrimental. In fact, powdering of the inhibiting material leads to more complete vaporization which affords equal protection for the part.

For some types of export packaging, Electro-Motive blows V.P.I. powder into a completed package with no harmful effects.

In the packing of such parts as the injectors, Electro-Motive has used V.P.I. paper for several years with no known defects that were attributed to a failure of the V.P.I. paper to perform satisfactorily.

Thus, with the exception of appearance, flaking of the inhibitor has no detrimental effect whatsoever.

Repairing Worn or Stripped Threads On GM Engine Parts

Engine parts having worn or stripped tapped holes may be repaired when replacement of the part is not otherwise justified. This can be done by employing precision-formed stainless steel wire thread reliners, namely, "Heli-Coil" inserts manufactured by the Heli-Coil Corp., Danbury, Conn.

These screw thread inserts have been tested and proven satisfactory for use in many steel, cast iron and aluminum parts of Series "51", "71" and "110" engine units.

Two types of inserts may be employed: one with an *unnotched-tang* and one with a *notched tang*. Inserts with *unnotched tangs* should be used when the bolt or stud in the assembly of the affected part will not bottom or press against the tang after the bolt or stud has been installed.

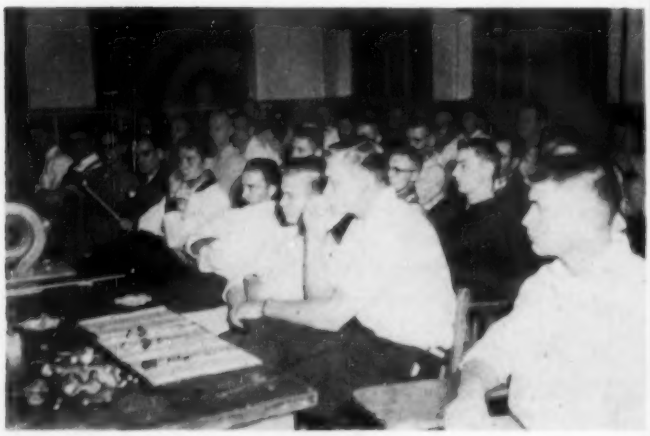
Inserts with *notched tangs* should be used when the attaching bolts or stud will bottom against the insert tang or pass through the entire length of the insert after the bolt or stud has been installed.

When installed, the insert provides a permanent thread that will accommodate the original size screw, bolt, or stud used. The insert will not shift, since it is held in position with a spring-like pressure, and will resist stripping, corrosion, galling, seizing, and rust for the life of the part repaired.

The nearest "Heli-Coil" distributor should be contacted for inserts, required special tools, and specific installation instructions.

Whenever "Heli-Coil" inserts are used in making repairs to tapped holes of Series "51", "71" and "110" engine parts, the responsibility for correct installation must be assumed by the person making the repairs. Any questions pertaining to the use of "Heli-Coil" inserts should be directed to the Heli-Coil Corp.

news of our industry



Society of Diesel Maintenance Engineers Formed

Members of the Diesel Department of the Nebraska State Trade School at Milford, Nebraska have organized a diesel servicemen's organization. The group is known as the Society of Diesel Maintenance Engineers. Founded in 1954, Articles of Incorporation and By-Laws have been drawn, and have been filed with the state.

The object of the organization coincides with a need within the diesel industry—professional improvement of the individual already in the field. The Society approaches their objective through monthly meetings, where members share problems and experiences. In addition, qualified speakers lecture on such things as fuel systems, and equipment allied to the diesel field. Meetings are both informative and interesting.

Recent topics discussed were the Cummins PT fuel system, the International Harvester fuel system, and Kiene test equipment. Discussion was directed by competent personnel within the organizations that manufacture and service the products. In addition, discussions of Caterpillar and Bosch equipment have been presented to date.

Average attendance at the meetings has been between seventy-five and eighty members. This is impressive, considering that some must travel more than a hundred miles to attend.

This kind of interest demonstrates the desire of the diesel man to improve himself, and advance within his field. This kind of spirit demonstrates a healthy industry.

The SDME provides membership for advanced students, graduate members, associate members, and honorary members. The group distinguishes itself as the only group of its kind in the field, and extends an invitation to other diesel groups to organize associate chapters.

Membership is representative of the industry, including men handling heavy and light equipment, high and low speed engines. It includes employers, foremen, mechanics, and factory service personnel.

The organization has met with a great deal of success. Each member benefits individually by the information presented, and so does the entire diesel industry.

new products . . . . . Page 61

new literature . . . . Page 72

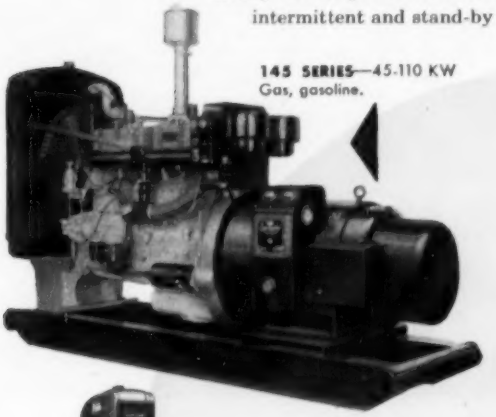
organizational news . . Page 76

NOW— a complete line of
WAUKESHA
Industrial ENGINATORS®

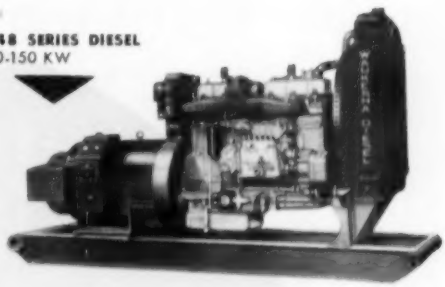
Waukesha now offers you a superb line of Enginators—backed by half a century of experience in building heavy-duty internal combustion engines and electrical equipment. Designed for reliable performance on all types of fuel, these Waukesha power units supply accurately balanced engine and generator combinations in applications requiring a smooth, steady flow of power for continuous, intermittent and stand-by duty.

50-600 KW • NATURAL GAS
LPG • GASOLINE • DIESEL

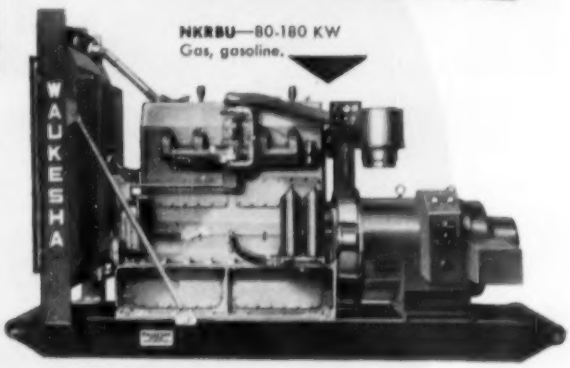
145 SERIES—45-110 KW
Gas, gasoline.



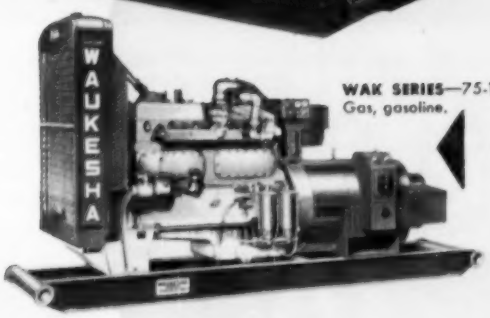
148 SERIES DIESEL
50-150 KW



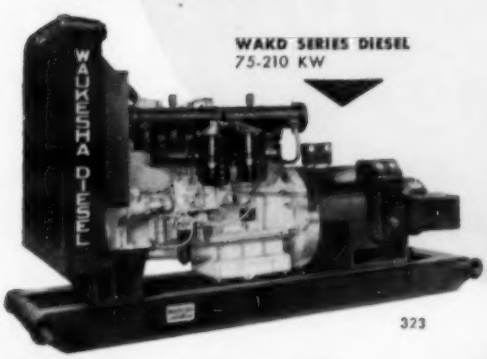
NKRBU—80-180 KW
Gas, gasoline.



WAK SERIES—75-170 KW
Gas, gasoline.



WAKD SERIES DIESEL
75-210 KW



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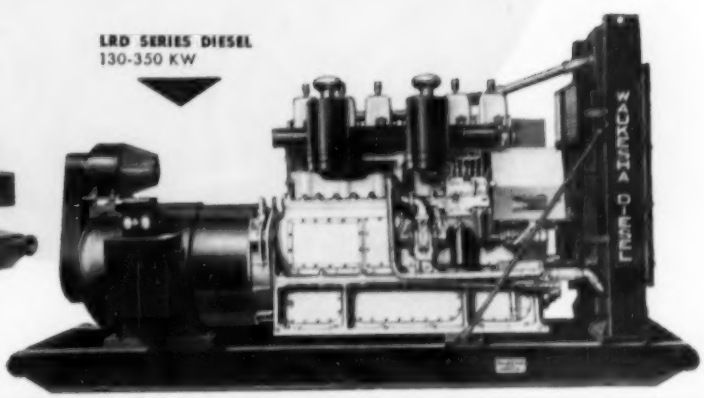
LRD SERIES DIESEL
130-350 KW



WRITE FOR BULLETINS FOR THESE AND OTHER MODELS.

WAUKESHA MOTOR COMPANY • WAUKESHA, WISCONSIN *RAILWAY DIVISION*

For every type of diesel operation—

FOR MECHANIZED DIESELS, there's a Cities Service diesel oil for every operating condition. Most widely used is Cities Service C-300 Motor Oil, which has improved performance and lowered maintenance costs for a host of truckers, quarry operators, and mining men. Shovel above logged 16,280 hours with no repairs, no increase in oil consumption. A Cities Service Lubrication Engineer will gladly show how you can achieve similar results.

the right track to greater profits

FOR RAILROAD DIESELS, Cities Service now offers a brand new oil . . . Pacemaker RD-80. Proven superior by over 50 million miles of operation on major railroads, new Pacemaker RD-80 reduces oil consumption up to 10%, cuts engine deposits 200% better than previous oils. Also gives superior protection of ring belt area. According to a leading engine builder, its oxidation stability is "the best of any oil tested."

is Cities Service Diesel Oil!

FOR STATIONARY DIESELS, Cities Service C-300 Lube Oil has won high praise from numerous users. Example: Paulding Light and Water reports 16,587,402 H.P. hrs. without oil change; gets 23,205 BHP hrs. per gallon consumed! For more information, write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

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new products

Portable Stacking Rack

Aimed at shops who want to streamline their parts-handling, Republic Steel Corp has developed a portable stacking rack. It can be moved by fork-lift or platform-truck either to load finished parts or transport replacement parts to where they are needed.

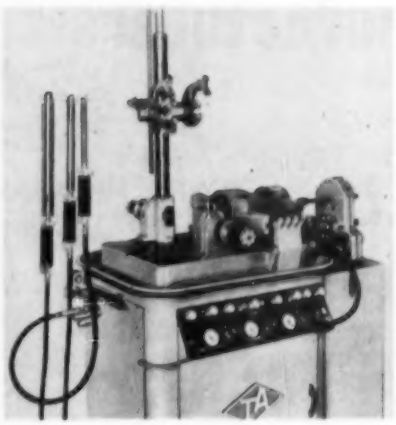
The open sides of the units facilitate order picking, tally and inventory work. At the same time they can be stacked to any practical height whether loaded or empty. Varying in size, the units are made to specification, according to the size and shape of material to be handled.

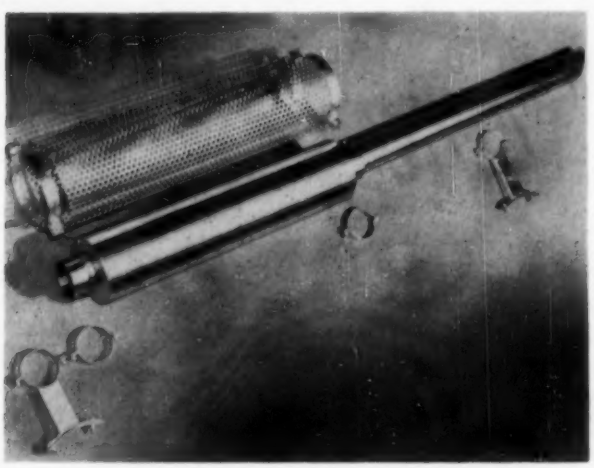
Faster Pin-Fitting for Diesel Engines

Tobin-Arp recently announced the addition of their new PM 900D Pin-Fitting machine, available for diesel engine rebuilding service. It is designed especially for precision boring of connecting rod bushings, cam-lever bushings, and rocker arm bushings. There is also an attachment for align-boring turbocharger bearings on the Cummins diesel.

Engineered for precision performance on all heavy-duty equipment, the new pin-fitting machine is designed to accomodate any boring operation accurately. The manufacturer claims that it will do the job in a remarkably shorter time than had previously been required. As an example, Tobin-Arp claims that precision rocker arm boring can be done in less than one minute per rocker arm.

Boring capacity is from 21/32-in to 2⅜-in. Connecting rod capacity is 3⅝-in to 23-in, center to center. The boring capacity, however, can be increased to 4⅛-in.





Diesel Exhaust Stack Kit

To make it easy and economical for diesel-powered truck owners and operators to install diesel exhaust system stack parts, a simple, ready-to-assemble "do-it-yourself" type kit is available. The single-cartoned kit includes stack, clamps, universal mounting brackets, muffler guard and muffler. Mufflers are engineered to meet the requirements of diesels in a wide variety of cubic-inch displacements with 3, 3½, and 4-in exhaust pipes.

Only a few simple tools are required to make the installation, and the manufacturer, Alexander-Tagg Industries, Inc., claims that one man can do the job in less than one hour.

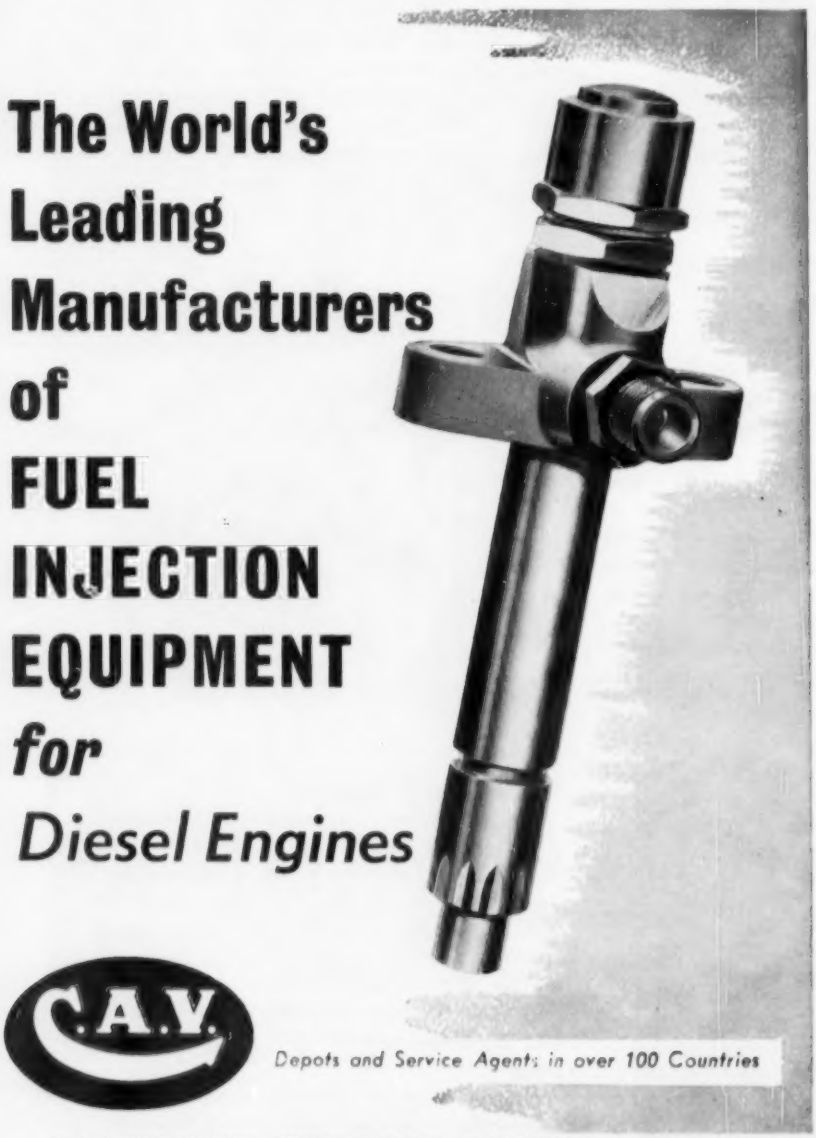
news of our industry

Leak-Proof Valve

Availability of a valve which employs a plastic seal to achieve permanent leak-proof quality under pressure of 725 psi has been announced by U. S. Valve Corp. To open or close the valve, a one-quarter turn is all that is necessary. It is designed to operate at up to 250°F and is claimed to require no maintenance nor lubrication after installation.

Buda Sells RR Supply Business

Inventories related to railway supplies are being moved to the Western Railroad Supply Co. from the Buda Div. of Allis-Chalmers. The complete line of Buda's railroad products has been sold to the supply firm, including jacks, car and locomotive replacers, track liners, bumping posts, car stops, rail and bonding drills, and its universal diesel nozzle testers. Buda will continue to manufacture engines and material handling equipment.



C. A. V. FUEL INJECTION EQUIPMENT DIVISION of LUCAS ELECTRICAL SERVICES, INC.
Head Office: 653 Tenth Avenue, New York 36, New York
Sales Office: 14820 Detroit Avenue, Cleveland 7, Ohio

AP 174-755

Fail-Safe Truck Brake

The end of run-away tractor-trailer tragedies is foreseeable with use of a new emergency brake, its inventor, C. J. Casey, claims. In one test-run, it brought a loaded vehicle to a stop in less than 200 ft. While the tractor-trailer was traveling in a restricted zone at 35 mph, the brake's air-supply line was deliberately cut, and the loaded rig came to a halt in 55 sec.

In other test-runs, the brake brought a vehicle traveling at 55 mph and carrying over 40,000 lb gross weight to a stop within 240 ft in 65 sec. The brake is made up of two units connected with an air line. One unit, a cylinder, is attached to the trailer axle, one for each wheel. The air line connects this with a set of regulating valves on the tractor cab. A plunger on the cab floor is the control.

Once the brake is applied, Mr. Casey states, it cannot be released until the air pressure for operating the regular air brakes has reached a normal operating level. This, he says, prevents the trailer from being moved until it is safe to be on the highway.

Portable Turbine

Developing 100-hp, weighing 175-lb, and compact enough to fit into a standard GI duffel bag—

These describe the Garrett Corp's new turbine. It is designed as a power unit for driving ground support or airborn generators, etc. It can also be mounted on jeeps, boats, trailers or aircraft as an auxiliary power unit.

More Diesels for British RR's

The $3 billion improvement program for the railway system in Britain is featuring an ever increasing use of diesel engines.

This in noteworthy when Britain has plenty of domestic coal for the steam versions, and must import oil for the diesels.

Sometimes you have to spend a little money to be really economical.

news of our industry

Drilled, Without Fail

Four Alco power-packages have been in service in the Gulf-coast oil fields—one for more than a year—and have provided continuous motive power for drilling without a single failure. These power packages, uniting simplified electrical control with reliable diesel power, are proving themselves capable in service.

Along with this, Alco offers a network of service personnel, manufacturing and warehouse facilities in the center of the oil industry.

Expanded Usage for Air-Cooled V-8

Four Wheel Drive Auto Co., after successfully introducing a new transport-tractor featuring a Deutz diesel engine, has increased the availability of the air-cooled V-8 to the FWD 32,000 to 40,000-lb four-wheel-drive units, and to the 36,000 through 40,000-lb six-wheel-drive units.

It would appear that the Deutz diesel engine worked very well in FWD's applications.

Drive Comfortably

Driver safety and comfort is a major concern of the Yellow Transit Freight Lines of Kansas City. They recently announced the purchase of 210 torsion-suspension truck seats for their highway units.

As the trucks operate over a great deal of rough terrain, the company felt that providing good equipment and maintaining it properly pays off.

Merger

Shareholders of Federal-Mogul-Bower Bearings, inc and National Motor Bearing Co., inc at separate meetings approved a proposal to merge the two companies. More than 79% of the stock voted in favor of the merger.

The agreement provides for the exchange of ten shares of NMBC stock for seven shares of FMB stock.

Transmission Under Glass

To check hydraulic controls on experimental automatic transmissions, GM's Engineering Staff's Transmission Development Group uses this specially-designed flow table. They can measure pressure and flow affecting all functions in the valve body or "brain" of a transmission, and determine how the valves would react in actual operation.

Handles on front of the device control oil pressure to various parts of the valve body, which is outfitted with gages.

Oil to Gas

Conversion kits are available for Cat D364 engines, allowing them to operate on gas as spark-ignited units. This may result in lower operating costs in areas where natural gas or similar fuel is obtainable at low cost.

The kits can be installed only on counter-clockwise rotation engines not equipped with turbos or blowers.

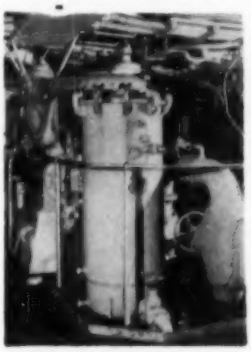
Modern Shop

Being completed by Briggs Transportation Co. of St. Paul, it is one of the most modern maintenance and overhaul shops in the area.

Records are kept on all phases of the firm's maintenance program. Separate records are kept for each piece of equipment, including a separate card for each tire and battery. Parts room proceedures have also been streamlined.

In all, the new shop epitomizes the latest ideas in shop layout and modern equipment.

WHY DO YOU ALMOST ALWAYS FIND THE BRIGGS TRADEMARK ON THE BIG, IMPORTANT INSTALLATIONS?



For Instance

THE USS FORRESTAL

BECAUSE marine engineers and maintenance engineers are convinced that Briggs long record of DEPENDABILITY and UNIFORMITY provides "that extra margin of safety and economy." Delivering foolproof performance on large and small jobs Briggs offers you the best dollar-for-dollar filtration buy.

WATER AND ABRASIVES REMOVAL FROM FUEL OIL OF SEA GOING VESSELS

Briggs

PIONEERS IN MODERN OIL FILTRATION

OIL FILTERS and FILTER/SEPARATORS

IF YOU BUY OIL FILTERS, BY ALL MEANS WRITE FOR THIS FREE FILTRATION BOOKLET

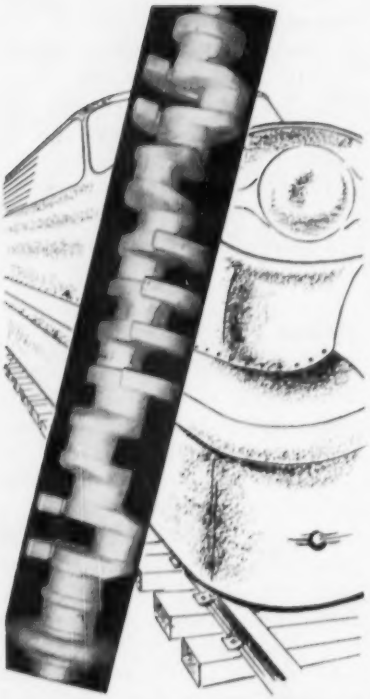
THE BRIGGS FILTRATION CO.
WASHINGTON 16, D. C.
DEPT. 124

YES! Send me a copy of the booklet pictured here.

Name _____

Company _____

Address _____



PARK "DIE-FORGED" CRANKSHAFTS

help power the trains of tomorrow

The new entries in the lightweight train race are designed to solve the problem of mounting deficits in passenger operation by cutting original, operating and maintenance costs.

Park Drop Forge is proud that Park "Die-Forged" Crankshafts are specified for the diesel engines that power these trains of tomorrow.

HEAVY DIE FORGINGS SINCE 1907

Diesel Crankshafts up to 4000 lbs.
Crankshafts and Connecting Rods
Aviation and Marine Drop Forgings

THE PARK DROP FORGE CO.
Cleveland 3, Ohio

What Do You Know!

(Answers to Questions on Page 41)

1. Correct answers are "a" & "c". Since this design permits use of more of the journal length for bearing surface, the pressure per square inch of area is lower. Use of two con rods on one bearing eliminates need for extra long journals which would be needed if each con rod had a separate bearing side-by-side. See article on Page 30.

2. Correct answer is "b". Having each journal round and straight does not necessarily mean that all journals have the same centerline. See article on Page 36.

3. Correct answer is "a". It's easier and cheaper to install new bearings while the engine is apart, being rebuilt, than to put in new bearings at a later date, and have the engine apart again and out of service. See article on Page 36.

4. Correct answer is "b". But "a" is more correct than "b". Taking most of the metal from the saddle places gears on crankshaft closer to driven gears and reduces the clearance between them. See article on Page 36.

5. Correct answer is "a". An example of a standard transmission used in conjunction with a torque converter is discussed in the article on Page 44. By clever ararngement of drive components, the range of application is continually being broadened to provide the advantages of hydraulic devices in different services at lower cost.

6. Correct answer is "d". Tests have proven that rate of oil oxidation is doubled for every 18°F increase above 200°F. See Page 46.

7. Correct answers are "a, b, & c" when these parts are made of aluminum; "d" is correct at all times since bauxite dust taken in with air contains aluminum. See Page 46.

NEW! Oakite SATUROL

... perfect for cleaning small diesel parts

Here's a brand new cold immersion cleaner that's just about perfect for reconditioning valves, pistons, filters, gears and other small diesel parts. It's Oakite Saturol.

What is it?

Oakite Saturol is a skillful blend of solvents for removing carbon, grease, paint, gasket compound and other tough soils. It has a high flash-point, is safe on metals. Comes ready to use, with a vapor seal floating on the solvent to inhibit evaporation — and give real economy.

How is it used?

Oakite Saturol comes in a special 6-gallon pail, complete with immersion basket. Immerse parts to be cleaned for ten minutes to half an hour, depending on type of soil. Lift out basket and rinse off parts with water or kerosene. It couldn't be easier. For large parts or volume cleaning of small parts, use tank-immersion method.

Call your local Oakite Technical Service Representative for a demonstration, or write to Oakite Products, Inc., 22C Rector St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS · METHODS · SERVICE
SCIENCE

Export Division Cable Address: Oakite

Technical Service Representatives in Principal Cities of U. S. and Canada

news of our industry

Longer Manifold Life

More service can be realized from exhaust manifolds if they are made from a nickel-alloy metal, claims International Nickel. Ni-Resist (a nickel-chrome manifolds alloy) are now standard on Alco locomotives, because of their resistance to heat.

The problem of manifolding breakdown has been aggravated by the higher temperatures and pressures associated with the increasing use of turbochargers.

Synthetic Rubber

A multi-million dollar expansion program to increase the output of the world's largest butadiene plant in Port Neches, Texas by 50% was announced by Texas-U. S. Chemical Co. The plant is owned jointly by Texas-U. S. and Goodrich-Gulf.

Butadiene is one of the principle ingredients of synthetic rubber. With production of the synthetic expanding, there is presently a shortage of the raw material. This expansion should help to relieve the shortage.

Some of the increase in production will be realized in 1957. Full production from the new facilities is scheduled for Fall, 1958.

Scholarship

The engineer shortage, present and future, is not news. Steps to help correct it are.

Scholarship program of the Garrett Corp. at three California schools has been enlarged. Stanford, University of Southern California and California Institute of Technology will each benefit from an additional scholarship, as well as one additional graduate fellowship each. Total has been increased from six scholarships to nine.

In line with the fellowship awards, it is intended that these grants be used for research in fields allied with the Garrett Corp's engineering programs.

what? all these Snap-on* sockets to drive just one size nut?

yes — AND HERE'S WHY: Every ¾-inch socket shown here solves a particular industrial nut-running problem. *Snap-on* makes this variety of ¾-inch hex wrench sockets and many more sizes and styles to give you just the one you need to match the job you have to do. Standard length, bolt clearance length, magnetic, Flexockets, power, power-impact and thin-wall types let you choose the socket to do your job faster and more efficiently, with less breakage.

ASK YOUR Snap-on MAN — If you have a production or maintenance problem involving special socket design or application, or any other question on tools, talk it over with your *Snap-on* man. He is a specialist who devotes all his time to industrial application of *Snap-on* tools. Write us or call your nearest *Snap-on* branch. Free catalog of industrial wrenches and hand tools is yours for the asking.

SNAP-ON TOOLS CORPORATION
8064-I, 28th Avenue • Kenosha, Wisconsin

*Snap-on is the trademark of Snap-on Tools Corporation.

news of our industry

Testing

Annual meeting of the American Society for Testing Material brought forth some pertinent discussion. Among these was a symposium on pH measurement, properties and applications of silicones, as well as metals, were discussed. Also such interesting things as "fatigue" and atmospheric corrosion of non-ferrous metals.

Cats for Missile Calibration

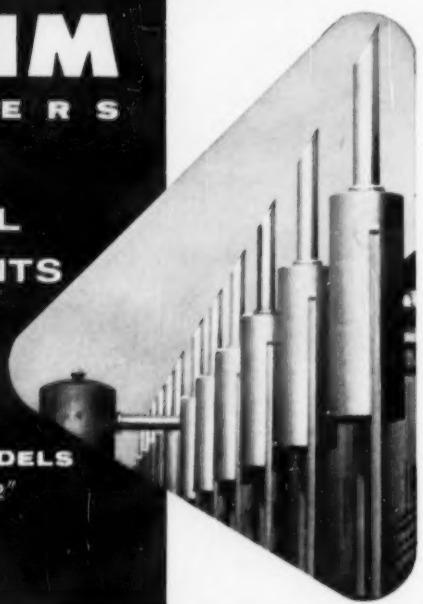
Caterpillar is supplying to Northrop Aircraft a special diesel-electric set to power the Snark Missile during calibration.

Missile accuracy is dependent upon precalibration of its guidance controls. The accuracy of the calibration is dependent upon the quality of the power used during the calibration period. Cline, Westinghouse and Caterpillar combined their efforts to supply an extremely sensitive and accurate source of power.

MAXIM

SILENCERS

FOR ALL INDUSTRIAL REQUIREMENTS



35 STANDARD MODELS

in sizes to fit 1" to 72" exhaust connections

Maxim makes the most complete line of silencing equipment available to industry. That means many "special requirements" can be solved with one of Maxim's "standard" units. If your problem is truly "special", Maxim's longer experience will help you get the answer more quickly and efficiently. Either way it always pays to consult Maxim first.

SILENCERS FOR:

- INTERNAL COMBUSTION AND STEAM ENGINE EXHAUST AND INTAKE
- AIR COMPRESSOR INTAKES AND DISCHARGES
- VACUUM PUMP DISCHARGES
- BLOWER INTAKES AND DISCHARGES
- STEAM, AIR OR GAS DISCHARGES
- JET AIRPLANE ENGINE EXHAUST AND INTAKE
- WASTE HEAT RECOVERY

THE MAXIM SILENCER COMPANY

93 Homestead Ave., Hartford, Conn.

Gentlemen: Please send bulletins on silencers for:

NAME.....

COMPANY.....

ADDRESS.....

Vacuum-Melted Alloys

Metallurgists are truly working in a vacuum. The Jet Age, with its supersonic speeds, has created the need for super-alloys. Melting metals in a vacuum draws off the gases that produce impurities and produces a purer, highly heat-resistant, and free-from-flaw metal.

Jet turbine blades made by the vacuum process are said to last up to four-times longer. A preview of the future shows the place of these metals in gas turbines for locomotives and vehicles.

Weights & Measures

Secretary of Commerce, Sinclair Weeks was the principle speaker at the 41st National Conference on Weights and Measures held in Washington, D. C. Total registration was 474, a new high.

Highlights touched were a symposium on Prepackaging, and the adoption of a tentative code for liquified-petroleum gas liquid-measuring devices.

Lube Research

Free-piston engine fuel and lube needs are being investigated by the Texas Co. at their main research center at Beacon, N. Y. A French Sigma engine is being studied, and is believed to be the first free-piston unit installed in a U. S. lab.

It will certainly not be the last.

South America Orders GE Units

Railroads in Chile and Brazil have signed up with General Electric for a total of $9 million in locomotive units. As part of its $4 million order, Chilean State Railways has bought the first 11 of a new universal line of diesel locomotives developed for foreign rails. They are narrow-gauge, 900-hp units.

In its contract, Santos A. Jundiai Railway of Brazil is to receive 45 wide-gauge, 720-hp diesel-electrics. The remainder of Chile's order includes five wide-gauge, diesel-electrics, developing 1600 hp and 15 wide-gauge locomotives of 720 hp.

news of our industry

Lubrication Testing Machine

Alpha Molykote Corp. has developed a lubricant-friction-wear testing machine, the first in a series of such testing equipment being planned by the company. The machine, to be known as Model LFW-1, is primarily for testing bonded coatings. It can also be used for liquid lubricants.

A small table model, it is said to maintain high loading accuracy while indicating friction forces throughout the test. A pre-setting device automatically shuts off the machine after it reaches a predetermined coefficient of friction.

Vest Pocket Tachometer

A pocket-size, plastic-contained tachometer, called the Sirometer, is the latest development of Precision Instrument Service. Placed on the housing of a running machine, it picks up speed readings by means of an indicator wire. When the wire reaches the resonance point, rpm can read on the upper scale of the instrument and cps on the lower scale. Direct readings range from 800 to 25,000 rpm.

Coated Welding Rods

Three new extruded heavy-coated bronze Oxyacetylene welding rods have been announced by Airco Co. International. They are especially designed for braze-welding and welding malleable iron, cast-iron, brass and bronze with dirty, oily or greasy surfaces. Three types of rod are available.

Type 20 (general), type 22 (high-strength) and type 27 (low-fuming) are also available with dipped coating for clean production work.

Hot-Spot Locknut

Self-locking locknuts for use at temperatures up to 1200° F have been introduced by Standard Pressed Steel Co. Designed for aircraft use, the new 119FW line is suitable for similar high-temperature applications, the nuts described as having the necessary characteristics to maintain tensile strength and resist galling and seizing after sustained exposure to high temperature.

The all-metal locknuts are one-piece and have a 12-point external wrenching design. A prevailing-torque type, each fastener has a slotted locking collar which is slightly squeezed in during manufacture. As the nut is threaded onto a bolt, the collar expands, spring tension holding the nut securely in place. This design is said to allow its service as a stopnut as well and permit repeated use. Standard sizes range from No. 10 through ½-in diam.

SPECIALLY ENGINEERED FOR DIESEL ENGINE REBUILDING SERVICE

TOBIN-ARP MFG. CO.
Announces the NEW

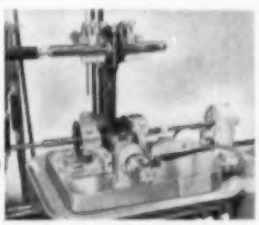
PM 900D PIN FITTING MACHINE

SPECIALLY ENGINEERED TO PRECISION BORE

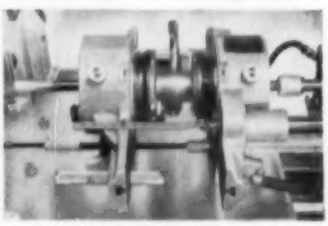
✓CONNECTING ROD BUSHINGS
✓CAM LEVER BUSHINGS
✓ROCKER ARM BUSHINGS

The PM 900D is a precision boring machine—capacity 2 1/32" to 2⅜". Connecting rod capacity 23". Boring capacity can be increased to 4⅛".

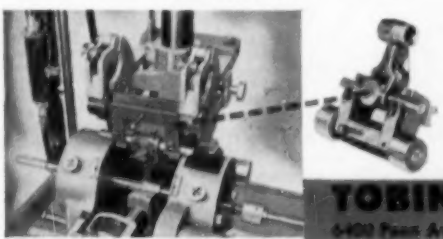
A TAMCO PRODUCT



1 Precision boring piston pin bushing parallel with crank pin bore, to specified center-to-center dimension.



2 Precision boring rocker arm bushings in less than one minute per rocker arm.



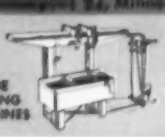
3 Precision boring cam lever bushings, parallel with roller shaft to specified center-to-center dimension, with Vernier Scale Control.

Write TODAY for complete information!

TOBIN-ARP MFG. CO.
6400 Penn Ave. S. . . Minneapolis 23, Minnesota

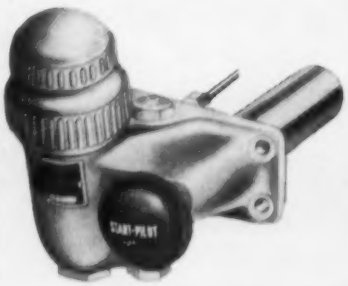
KING PIN FITTING MACHINE

TAMCO PRECISION VALVE REFACER


LINE BORING MACHINES

START PILOT

FOR INSTANTANEOUS DIESEL STARTING



STARTS YOUR ENGINE AT MINUS 60°F.
SAVES UP TO 50% ENGINE WEAR

DESIGNED FOR

ALL TYPES OF

DIESEL ENGINES

DISTRIBUTED BY

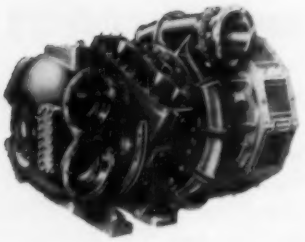
- START PILOT CORPORATION
  258 Herricks Road
  Mineola, N. Y.
- WILCO COMPANY
  4425 Bandini Boulevard
  Los Angeles 23, Calif.

Please send me additional information on the START PILOT device and the START PILOT fluid.

NAME .....

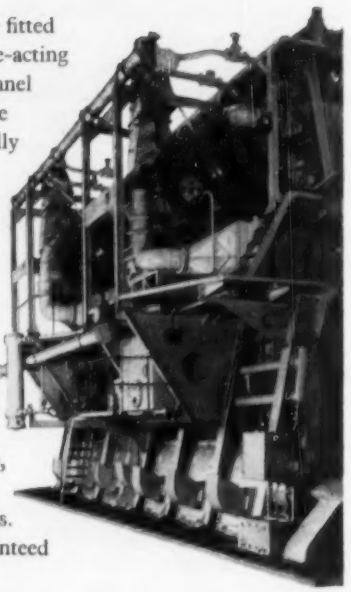
COMPANY .....

ADDRESS .....



Harland & Wolff

chose these Napier Turbo-Blowers



Two Napier Type MS 600 turbo-blowers are fitted to the Harland & Wolff S.A. 6. 8,000 h.p. single-acting two-stroke Diesel which powers the Blue Funnel Line M/S DEMODOCUS. The S.A. 6 is one of the first engines of its type to be successfully turbo pressure-charged without the use of mechanically driven scavenge pumps. Why did Harland & Wolff choose *Napier* turbo-blowers? Here are three good reasons—

- Napier blowers have *high adiabatic efficiency*, resulting in maximum power increase and low fuel consumption.
- Journal bearings on the MS 500 and 600 Napier blowers are sleeve type, and with proper lubrication they will last as long as the engine itself. The MS 500 and 600, the largest blowers in the Napier range, are built especially for marine applications.
- A high standard of workmanship is guaranteed by Napier's long experience in precision engineering.

Napier turbo-blowers are available in seven sizes for engines of 140-4,000 h.p. afloat and ashore. Multiple installations for engines of higher powers. On 4-stroke Diesels they can double the power, on 2-strokes they increase it by over 30%—often at a lower specific fuel consumption. Napier turbo-blowers are currently in use in 69 countries.

for this engine

which powers this ship

NAPIER Turbo-blowers

D. NAPIER AND SON LIMITED · LONDON · W.3 · ENGLAND

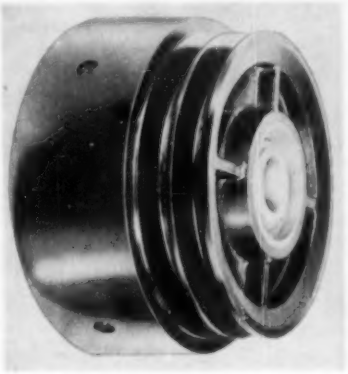
REPRESENTATIVE: L. O. BROOKS, SUITE 909, DUPONT CIRCLE BUILDINGS, 1346 CONNECTICUT AVENUE N. W., WASHINGTON 6, D. C. TEL.: DUPONT 7-2123

CBC19

new products

Automatic Engage-Disengage Clutch

An automatic engage-disengage clutch for power transmission in the 10 to 50-hp engine range is now offered by the Salisbury Corporation. Called the Tog-O-Loc clutch, it has a disengagement speed approximately 400 to 500-rpm lower than its engagement speed.



The manufacturer describes this as differing from the ordinary clutch, which picks-up and releases at about the same speed. This is said to provide for idling without slippage, and provide greater capacity in proportion to weight.

Long, trouble-free performance is claimed due to the large friction area and simple construction.

Oil & Water Filter Cartridge

A filter cartridge made by the Hilliard Corp. uses Tuflite. This new filter material consists of graded cotton fibres felted into sheets. These are impregnated with a thermo-setting plastic resin that is insoluble in either oil or water.

Cartridge is designed for high flow-rate, low pressure-drop, and down to 5-micron filtration.

Hilliard markets the cartridge for fine filtration of all types of lube, fuel and industrial oils, as well as many aqueous solutions, such as coolants.

Flexible Coupling with Brake-Drum Flange

A coupling incorporating a brake-drum flange on the outer diameter is now available from the Lovejoy Flexible Coupling Co. They claim that this feature provides a compact drive arrangement that is particularly useful where shaft length is a problem. The brake drum takes no more space than that required by the flexible coupling.

Coupling is to be had in eight standard sizes, with hp ratings from 2 to 40 at 1750-rpm. Maximum hub-body bores range from 1 to 2½-in. Drum-body bores are made to motor-shaft size. Distance between shafts runs from ½ to 1⅝-in. Cushions are one-piece spider type.

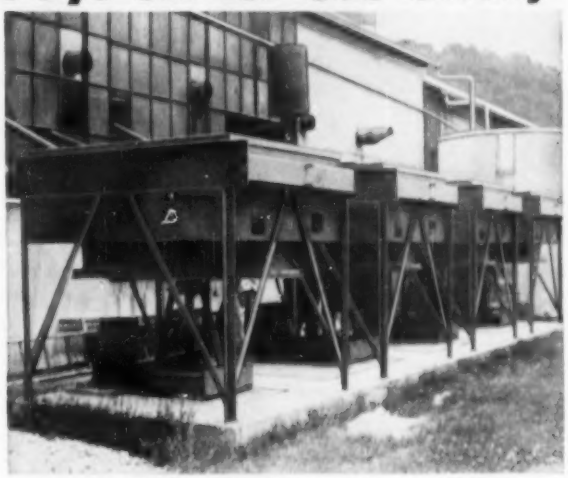
Hex Head Driver Set

Snap-On's new set turns 5/32-in through ¾-in hex-head screws. Designed for use with any combination of socket wrench handles, Snap-On states that hard-to-reach screws can be turned safely and easily.

Bits are specially hardened to withstand heavy use, and are replaced easily when worn. Bits are held in sockets by roll-pins, which extend through socket and bit, rather than by set screws.

Young Engineering Talent

Pays off for Gas Utility*



*South Penn Natural Gas Co. Station, Smithfield, West Va.

Young "HC" Atmospheric Radiators

eliminate cooling water supply problems

The Problem: To replace an old cooling tower serving gas compressors. A nearby creek furnished the uncertain water supply.

Young HC Horizontal Core Cooler and Condenser

How Young solved it

Four Young Radiator Company HC Atmospheric Radiators were specified to cool four 165-hp compressor engines. Natural gas is compressed from local field lines and well-head to pressures suitable for shipping to distant sales points. Installation of the Young Units has modernized the compressor cooling system. In addition it has made the utility independent of the uncertain water supply.

A. Independent mounted fans eliminate unit vibration.
B. Coils designed for easy access to tube ends.
C. Coils supplied for any operating pressure.
D. Steel tanks treated for corrosion resistance.

Write Dept. 416-J for FREE Catalog

Put Young Talent to work for you . . .

Solving heat transfer problems is what we do best because it is our very reason for being. You, too, can harness the power of Young engineering talent. Write, wire or call without obligation.

HC is a registered trademark.

Young RADIATOR COMPANY
RACINE, WISCONSIN
Creative HEAT TRANSFER ENGINEERS FOR INDUSTRY
Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.
Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

How much of your engine maintenance bill is due to repair of breakdowns that could have been avoided—*if you'd had advance warning?*

At a fraction of that cost, Alnor Exhaust Pyrometers offer you a constant check of engine performance—advance warning of

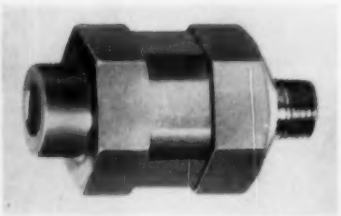
Cylinder Overload **Preignition**
Scaled Jackets **Clogged Ports**
Detonation **Faulty Injection**

Get the best from your diesel—minimum fuel consumption per horsepower and long service uninterrupted by foreseeable breakdowns. Get constant protection of your engine, cylinder by cylinder, with an Alnor engineered Exhaust Pyrometer System.

Get Full information—Quickly! Your nearby Alnor Diesel specialist is conveniently listed in the classified directory. Ask him to help you select the Pyrometer and thermocouple assembly designed for your engine. Or send for Bulletin 4361 with complete details of the full Alnor line of Pyrometers.

ILLINOIS TESTING LABORATORIES, INC.
Room 507, 420 N. La Salle St., Chicago 10, Illinois

new products



Air Tank Check Valve

To meet the new ICC brake safety regulation deadline of Sept. 30, Airbrake Accessories, Inc. is offering a new check valve for immediate shipment to truckers. It is made of heavy-duty brass, has no seat, and requires no extra fittings to install. Thread sizes of ¼, ½, and ¾ in are available to fit varying pipe diameters.

Manifold Protecting Paint

Metal surfaces, such as exhaust manifolds, can be protected by Thermalite high-heat aluminum paint, produced by Tropical Paint Co.

Thermalite is formulated with a heavy silicone content. It is claimed to fuse to the metal surface, and not discolor, blister, flake or burn off, even at 1000 degrees.

Paint is available in two applications, exterior and interior. One coat is all that is said to be needed.

New Tractor-Shovel

The HD-6G is the newest of Allis-Chalmers' addition to the line.

Featuring a 57-hp engine at 1800-rpm, the HD-6G retains the engineering identified with the rest of the line—power, sturdiness, easy maintenance.

A two-position bucket is standard equipment. It provides versatility, as the operator can select either of two bucket positions, depending on job conditions and material.

In light, loose dirt, operator uses the 25° tilt position, to get bigger load and less spill. In hard dirt or heavy materials, bucket can be converted to general-digging position by changing the bucket mounting pins.

Utility and versatility seem to be the by-words.

Heavy-Duty Grinding

Morton has completed a machine for grinding long members. It will grind either straight surfaces or long-curve irregular surfaces to template.

Machine is basically a traveling wheel type, the work remaining stationary. Drive gives a power flow in speeds up to 100-fpm.

Provisions can also be made for coolant-collection and return in the foundation.

Welding Pipe

Lincoln Electric has announced a new E-6010 electrode, Fleetweld 5-P. It is said to be suitable for all E-6010 applications; but especially designed for pipe welding, such as engine-system piping.

It is available in ⅛ and 5/32-in diameters.

Dynamic-Type Level Detection Switch

Automation Products, inc. has produced an interesting type of control for the detection of fluid levels. They claim it to be simple, fail-proof, and accurate.

In operation, the control consists of a "motor-generator" driven at resonant frequency by an alternating current input. Generator output energizes a relay to control operation of any type electrical equipment. For high-level detection, generator output ceases due to fluid-level rise stopping the vibrating paddle. This de-energizes the control relay. For low-level detection, low-level allows paddle to vibrate, and generator output energizes the control relay.

Your assurance of EFFECTIVE FILTRATION

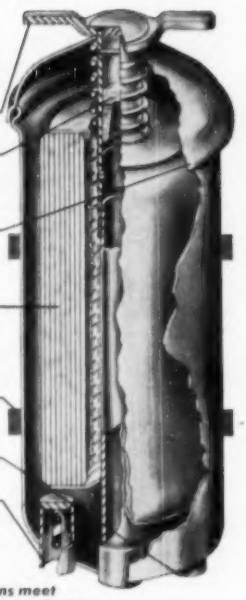
ENGINE LIFE

LUBE AND FUEL OIL FILTER CASES

Guarantee THE ULTIMATE IN OIL CONDITIONING!

Check THESE ENGINEERING FEATURES:

- *Hand control* for quick servicing. No wrenches required.
- *Exclusive dual purpose by-pass design* insures full oil pressure for maximum engine protection and longer element life.
- *Functional "O" ring seal*—The greater the pressure, the greater the seal. Eliminates constant gasket replacement.
- *Elements* are designed to give a maximum of filtration, accomplished by the use of perfected filtering media in relation to service requirements.
- *Sturdy clamp-type mounting* for safe installation under all conditions.
- *Drain* is located at the bottom of oil sump.
- *Inlet at bottom* for ease and safety of installation. Inlet check valve prevents drainback and undesirable turbulence.



Over-all dimensions meet truck or industrial installation requirements.

FULL FLOW FILTRATION

Oil conditioning and full flow protection to all precision working parts of the engine are incorporated in the same unit. Cases are designed so that new elements may be replaced in a matter of moments.

Request complete catalog listing all sizes and capacities of Engine Life Filter Cases.

A complete line of filters and replacement elements

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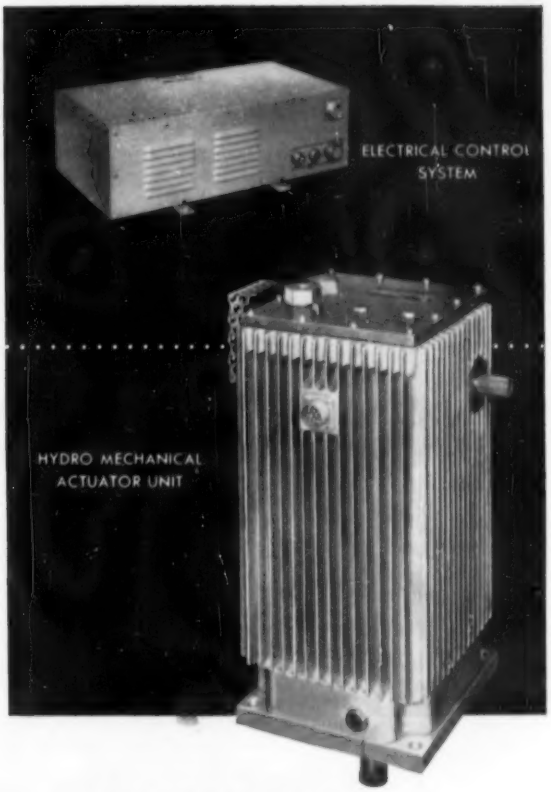
ENGINEERED FILTRATION SERVICE

INDUSTRIAL AUTOMOTIVE MARINE & AGRICULTURAL



ADVANCED . . .

The Westinghouse electric governor features isochronous paralleling of two or more units

Automatic isochronous load sharing by two or more engine-generator sets is now possible with the new Westinghouse electric governor. Combined set operation has the same precise performance as during separate unit operation.

Governor has no electronic tubes, works on zero speed regulation. Up to five per cent adjustable speed regulation is available for conventional parallel operations.

Suitable for diesel and gasoline engine-driven generator sets from 30 kw through the largest sizes; 50/60 cps or 400 cps. Designs available to meet full military environmental requirements. For complete details send coupon below. J-21966

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Westinghouse Electric Corporation
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new literature

Aluminum Casting Alloy

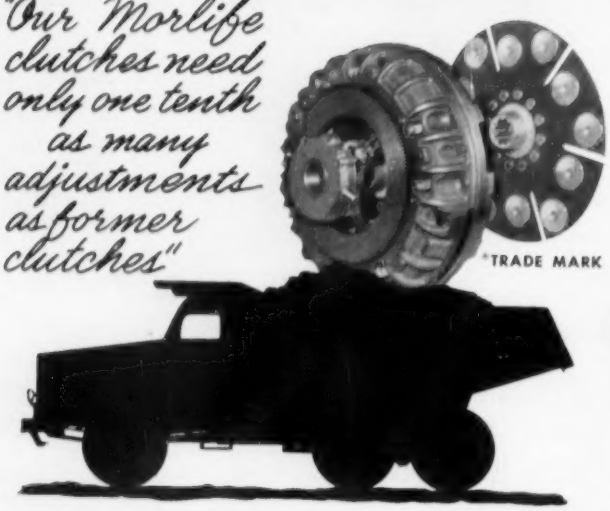
properties and characteristics, giving factors to consider for choosing among three casting methods, are available in Series No. 8, offering of Kaiser Aluminum & Chemical Sales, Inc.

Simplified Welding Procedures

for every base metal are featured in a 140-page pocket data book available free from Eutectic Welding Alloys Corp. It covers 120 welding rods, electrodes, and welding compounds.

ROCKFORD

"Our Morlife clutches need only one tenth as many adjustments as former clutches"



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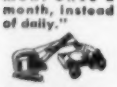
"MORLIFE clutch has gone 851 hours without slipping or adjustment."

"MORLIFE clutch going strong after 1695 hours, working in sand."

"MORLIFE clutches last 950 hours longer, without adjustment."

"MORLIFE clutch needs adjustment once a month, instead of daily."



"MORLIFE requires lighter handle pull and one tenth the adjustments."

"MORLIFE pulls harder and lasts six to ten times longer."

"Won't buy a unit that isn't equipped with Durable MORLIFE clutch."

New MORLIFE* CLUTCHES and CLUTCH PLATES Give-

MORE Clutch Life (400% MORE)
MORE Torque Capacity (100% MORE)
MORE Heat Resistance (50% MORE)

These *new* ROCKFORD Clutches and Clutch Plates have been developed by ROCKFORD Clutch Engineers to take full advantage of recently discovered facing material. Actual field tests on heavy duty equipment have resulted in adoption of MORLIFE clutches by builders of tractors, earth movers, graders, shovels, cranes, trucks, oil field equipment and power units. For information how these *new* Rockford MORLIFE Clutches will improve the operation and increase on-the-job hours of heavy duty machines, write Department E.

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1301 Eighteenth Ave., Rockford, Illinois, U.S.A.
Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

CLUTCHES

In-Place Balancing

of parts rotating at 225 to 3600 rpm is illustrated in a 12-page bulletin from Tinius Olsen Testing Machine Co. Features and operating principles of the Vibrodyne balancer are given along with typical applications and several case histories.

Powder Metallurgy Products

such as self-lubricating bearings, finished machine parts, and permanent metal filters, are contained in a 52-page engineering manual issued by the Amplex Div. of Chrysler Corp.

Humidity

recording and control instrument information is described and illustrated in a 22-page bulletin by the Bristol Co. Info is furnished on indicating, recording and automatically controlling wet and dry bulb instruments and psychrometers.

Report on LPG Fume Elimination

Oxy-Catalyst, Inc., manufacturer of the Dieseler, a catalytic muffler for diesel engines, has issued a report on its OCM catalytic exhaust purifier for LPG-powered engines. A Clark Utilitruc powered by an LPG-converted Continental engine was used as the test vehicle.

The findings show that the purifier eliminated an average of 99.7% of carbon monoxide, 88.8% of hydrocarbons, and 83.9% of aldehydes at governed speed, and 100% at idle. The equipment is also reported to have effectively reduced the odors caused by the ethyl mercaptan additive used in LPG.

Presence of the noxious elements was shown in the exhaust stream before it entered the purifier, to indicate that LPG-powered equipment should not be operated in confined areas without substantial elimination of these substances. The report is available for free distribution.

new literature

Liquid Petroleum Gas

storage standards have been published by the National Fire Protection Assn. They include:

NFPA#59, "Standards for the Storage and Handling of Liquified Petroleum Gases at Utility Gas Plants", (35 cents);

NFPA#58, "Standards for the Storage and Handling of Liquified Petroleum Gases", (35 cents);

NFPA#52, "Liquified Petroleum Gas Piping and Appliance Installations in Buildings", (50 cents);

NFPA#51, "Standards for the Installation and Operation of Gas Systems for Welding and Cutting", (35 cents).

Revised Welding Catalog

has been announced by Modern Engineering Co. Revised edition of #150 General Welding Catalog covers their complete line of oxy-acetylene welding and cutting torches, machine cutting torches, regulators, pressure gages, hose connections, couplings and safety equipment.

Welding Rod

of nickle-brass is described in "Ampco-Braz #1 3-in-1 Filler Rod" announced by Ampco Metal, Inc.

An Advance in Technique

of alternator regulation and control is described in an 8-page booklet by Electric Regulator Corp. It is explained that the info can simplify new designs and be easily installed in existing equipment. Bulletin is #5.08.

"Contractor's Decision"

is the title of a new color-sound 16-mm film made by Euclid Div., GMC. The ten-minute movie covers the three major concerns of a contractor who operates scrapers—performance, dependability, and component accessability for ease of maintenance. Arrangements can be made to borrow a print of the film.

The ABC's of Modern Plastics

for those who want to know something more about this growing product, has been published under that title by Bakelite Co.

Nickel Cadmium Batteries

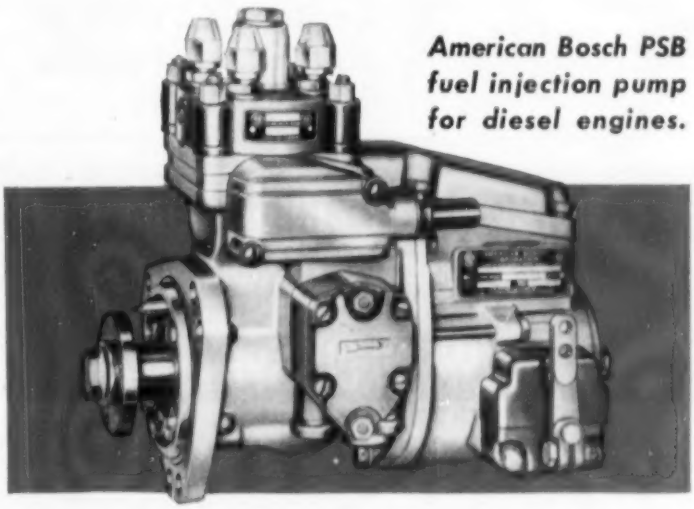
for engine starting and control and standby service are covered in two bulletins offered by Nickel Cadmium Battery Corp.

Iron Castings

with molybdenum as an alloying element are considered in a series of bulletins available from Climax Molybdenum Co.

Diesel Fuel Pumps

in service throughout its marketing area have been compiled by Esso Standard Oil Co. The listing gives city and station location, grade of fuel offered, and hours of operation.



American Bosch PSB fuel injection pump for diesel engines.

Unmatched for service and performance . . .

That's the record of more than 100,000 American Bosch PSB fuel injection pumps now in service—some for as long as five years. The PSB has many features—simple rugged construction, fewer parts, accurate fuel metering and distribution, positive governor control. Easily replaceable hydraulic head permits quick field servicing. All combine to assure top engine performance and economy of operation, long trouble-free life and *low* maintenance expense.

NOW . . . OWNERS OF INTERNATIONAL HARVESTER DIESELS can install the American Bosch PSB pump on their engines and enjoy its many advantages. Complete installation kits are available. For details, contact your nearest American Bosch dealer or write American Bosch, Dept. 555., Springfield 7, Mass.

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Division of

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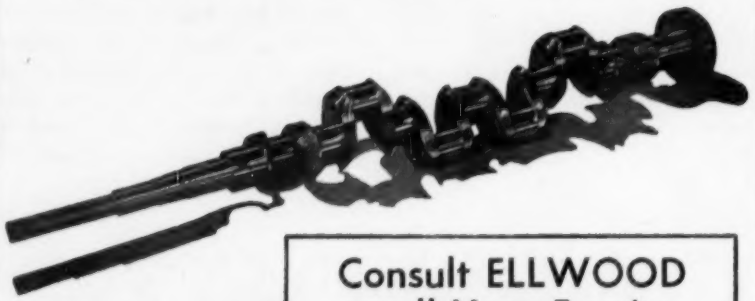

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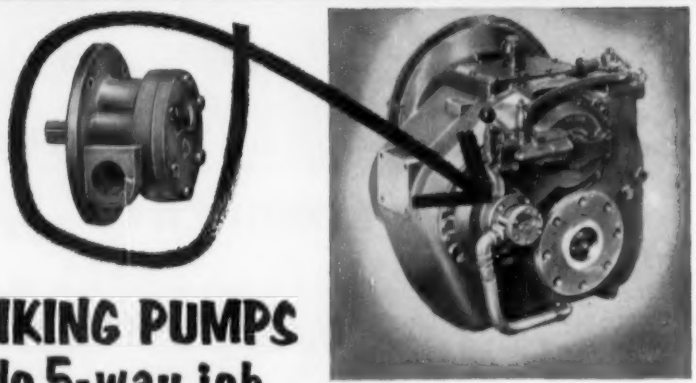


VIKING PUMPS
do 5-way job
on Twin Disc Clutch's New Marine Gear

Twin Disc Clutch Company, Racine, Wisconsin, designed their new MG-11 Marine gear for the new high speed, high horse power marine engines. They spent three years in research, designing, planning and testing. Viking Pumps were selected to perform five functions—1. Actuate the clutches, 2. Carry heat away from clutches, 3. Give smooth clutch engagements, 4. Reduce clutch plate wear, and 5. Force-feed lubricate meshing gears.

Besides marine use, Vikings are pumping dependably in petroleum, chemical, foods, and many other fields. If you have a pumping problem, call on Viking.

To start, write for bulletin 56S d.

VIKING PUMP COMPANY
Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" pumps
See our catalog in Sweets

new literature

Gas Turbine-Electric Locomotive features are described in a new booklet, GEA-6499, available from General Electric. Four color illustrations and diagrams cover the locomotives history, operating principle and advantages.

Hydraulic Torque Converters, heavy-duty single-stage for transmissions of 100 to 1000-hp, are described in bulletin #468 by National Supply Co. Bulletin gives features and specs of 17 sizes and capacities.

Set Screw Descriptions, listing every type of standard set screw are available in a 28-page Catalog #21 by the Set Screw & Mfg. Co.

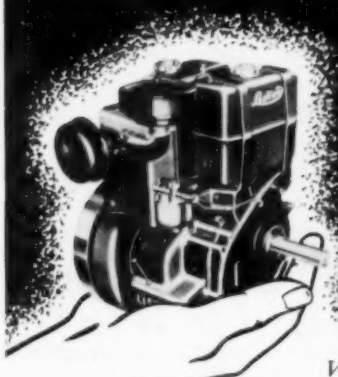
Heavy-Duty Truck Transmission operation, maintenance, parts inspection, and trouble shooting are the topics of a booklet available from Fuller Mfg. Co.

Vinyl Acetate Monomer bulletin of 20-pages has been published by Air Reduction Chemical Co. Included is information on physical properties, grades, specs and handling. Also details on polymerization and chemical reactions.

Overhead Material Handling is discussed in bulletin #2008-M of Cleveland Tramrail Div., Cleveland Crane and Engineering. Booklet covers components of overhead systems, track design and support, with formulae. Included is a large amount of illustrative material.

Splicing Information for line of "Scotchcast" brand splicing kits (MM&M) is found in a 4-color illustrated booklet. It describes in detail the "unipak" container of "Scotchcast" electrical insulating resin #4 for pouring field-encapsulated splices.

MORE POWER TO YOU



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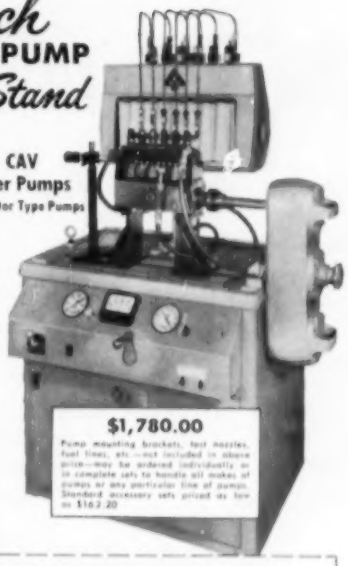
- Fuel supplied from built-in reservoir by motor-driven pump. Two replaceable cartridge filters.



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Pump mounting brackets, test nozzles, fuel lines, etc.—not included in above price—may be ordered individually or in complete sets to handle all makes of pumps or any particular line of pumps. Standard accessory sets priced as low as $162.20

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new products

Very Clean, Indeed

A new, waterless, liquid-cream hand cleaner has been developed by American Detergent Co. They state that iodine, inks, dyes and carbon are but a few of the foreign matters that are removed easily from the skin.

In addition, skin conditioners are added as well as an antiseptic. The manufacturer claims that it has the mildness of a fine face soap.

Attention is directed toward the "on-the-job" user, as a sturdy mounting bracket is available. Quantity purchases vary from the 12-oz can to the 55-gal drum.

Silicone Defoamer

A silicone defoamer has been produced by Dow Corning, that they claim to be fast acting and stable. It is called Antifoam B.

The manufacturer states that it is instantly dispersable in aqueous systems, and may be added "as is" without stirring or agitation. It will not oil out, plate out, settle or precipitate in most applications.

Dow Corning has tested Antifoam B in the lab and in the field, and it is ready to be shipped in commercial quantity.

Air-Powered Chain Block

Atlas Copco Eastern's new 55-lb chain block is capable of lifting up to 900-lb at a speed of 36-ft per minute. The hoist is designed for maximum lift and operates from a half-inch air line at a pressure of 85-psi. It draws 1.6-cu ft per hour of air, per foot of lift.

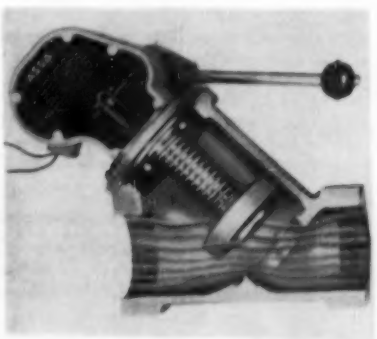
Designated the MT-504, it is designed to fill the needs of machine shops and to operate at contractors work sites. At the latter, there are many instances when air is available, but not electricity.

Safety Shut-Off Solenoid Valve

A manual-reset solenoid valve is available from the Automatic Switch Co.

Valves are designed to control the flow of manufactured, natural and L-P gases in a maximum ambient of 104°F. They also handle various grades of fuel oil and non-corrosive liquids and gases.

Sizes are available from ¼-in to 6-in IPS; pressure from 25 to 100-psi.



organizational news

Appointed as a Consultant
on engineering and development problems by Alco Products, Inc., R. Tom Sawyer leaves the post of research manager which he has held since 1953. In addition to his Alco duties, he has become a consultant at Stevens Institute of Technology where he will work on Army development projects.

Moved Up
at International Harvester Co., Howard S. Manwaring is now director of engineering. In addition to his general administrative duties, he'll be especially concerned with motor truck and construction equipment engineering activities.

A Newly Created Post
has been awarded to Stan Fein at R. G. LeTourneau, Inc., that of advertising supervisor. He recently ended nine years of service at American Air Filter Co., Inc.

Stan Fein

H. A. Morris

Elevated to Sales Manager
at Nickles Machine Corp. is H. A. Morris. He'll be succeeded as Permian Basin representative and sales engineer by Jack M. Ray.

Two Promotions
at the Buda Div. of Allis-Chalmers Mfg. Co. involve the elevation of J. C. Baseheart to engine sales manager and F. M. Borwell to assistant engine sales manager. Mr. Baseheart was formerly in charge of engine sales and Mr. Borwell was a special district representative.

Recently Appointed
administrative assistant to the division president is Howard E. Blood, Long Mfg. Division, Borg-Warner Corp. In his new post, Mr. Blood will coordinate activities of the industrial relations, purchasing, quality control, research and product engineering departments.

Joining the Staff
of the Oil Industry Information Committee in Philadelphia will be Harry S. Phillips. He was the Great Lakes representative of the OIIC.

Photo, courtesy Kahlenberg Bros. Co., Two Rivers, Wisc.

Tuthill pumps are built for uninterrupted service. They're just the equipment you can trust for such vital jobs as positive lubrication on diesel engines and power units. The complete line of Tuthill positive displacement, internal-gear rotary pumps includes automatic reversing pumps and stripped models for built-in applications. We specialize in short runs of special pumps for engineered applications.

Write for data on Tuthill Lubrication Pumps.

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Dependable Rotary Pumps . . . since 1927
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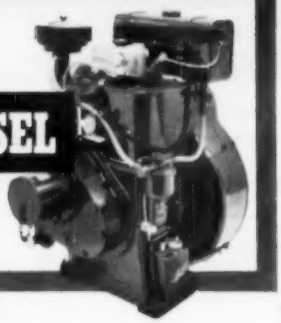
family yet?



In the rugged PETTER diesel family are aircooled and watercooled models all the way from 1½ hp (the toughest baby yet) to 48 hp. And long, faithful service is an old Petter family tradition; witness the more than 400,000 Petters in use throughout the world.

The Petter motto is "*ubique*" (we get around). You'll find Petters driving well pumps in the Persian Gulf, irrigation systems in India, marine auxiliaries in Louisiana, standby generators in Connecticut. There isn't a piece of powered equipment in its range for which a Petter can't do a better, dieselized job . . . cut running costs and fire risk.

For rugged power in junior sizes, check the Petter range today! Write for information—a few choice dealerships are still open.

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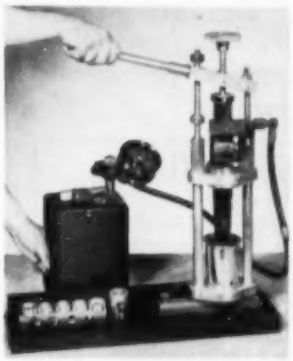
KIENE CONNECTOR NUTS — For convenient Attachment of Equipment to Test Stand or Test Pump. All sizes Connectors available.



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organizational news

Appointments of GMC include:

W. G. Cobb to asst-manager fo the NY region of the public relations staff; he succeeds R. C. Kopke, named public relations manager of the Buffalo region. Victor H. Garske will succeed Mr. Cobb as director of the GM Previews of Progress at Detroit.

Reorganizational Move placed Frank Nelson in the newly-created position Manager of Industrial Supply Operations. He was formerly manager of Garrett Supply division in LA and Phoenix, and in charge of C. W. Marwedel Co., San Francisco subsidiary.

Robert Daniels took his managerial spot, Jack Hardy became asst, and Bill Grandall sales-manager for Marwedel.

New Top Management changes announced by Ohio Crankshaft Co. include Foster H. Pettay, elected president. At the same time, M. J. Hoke was appointed senior VP and general manager; Paul T. Koenig was appointed as Secretary and Treasurer.

F. H. Pettay

M. J. Hoke

P. T. Koenig

Two Executive Changes have occurred at Minneapolis-Moline Co. Wayne H. MacFarlane is now vice president - administration. His former post as director of engineering will be occupied by William E. Swenson.

In Memorium

Harold F. Hess, executive VP of the Construction Industry Manufacturers Association (ARBA Manufacturers Div) since 1949, died suddenly in Chicago on August 3, 1956.

Feelings were summarized by ARBA president J. N. Robertson, who said his passing was a sad loss to all segments of the highway industry.

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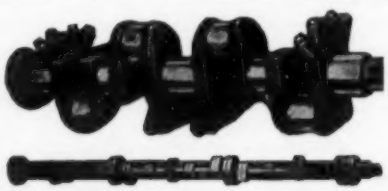

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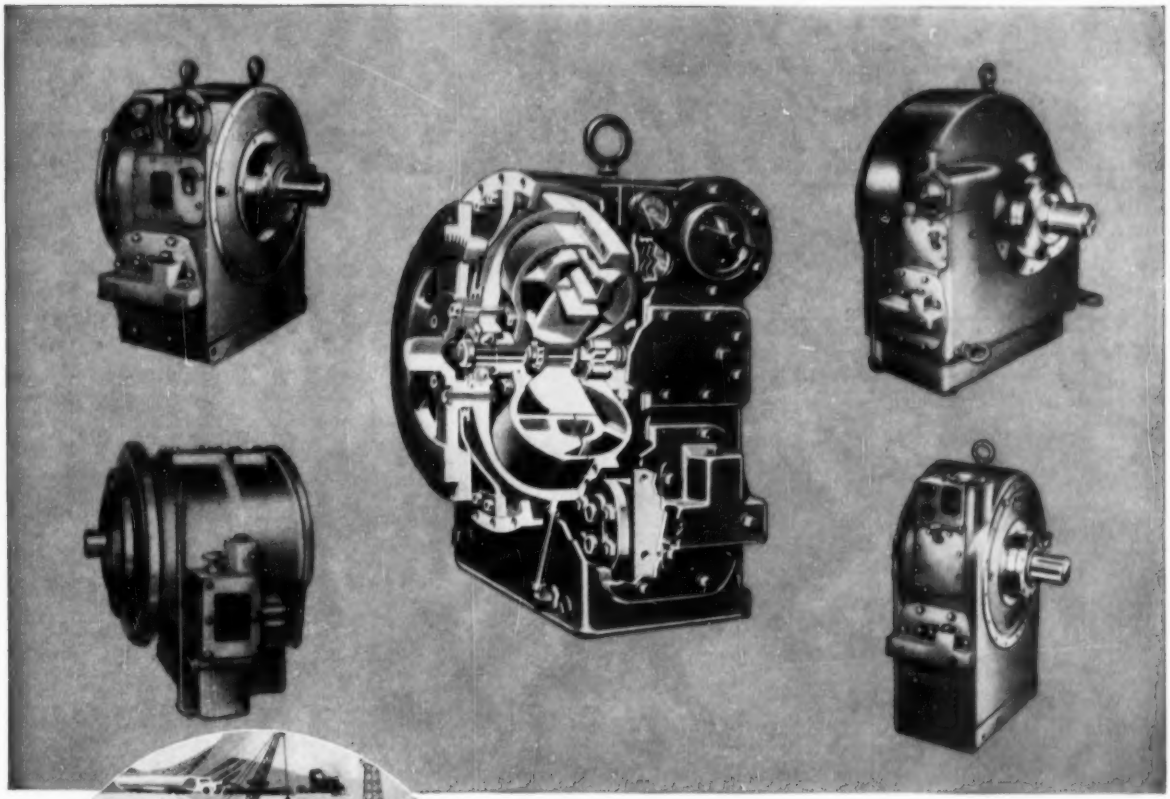

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(l. to r.) Carl Olbertz, Milford plant superintendent, "Rollie" C. Bleimehl, Standard Oil industrial lubrication specialist and Frank Morgan, Milford chief engineer inspect crankcase. Rollie Bleimehl is qualified to give technical service on jobs like this. He's been doing this sort of work for 10 years. Rollie has a mechanical engineering degree from Iowa State College and has completed the Standard Oil Sales Engineering School.

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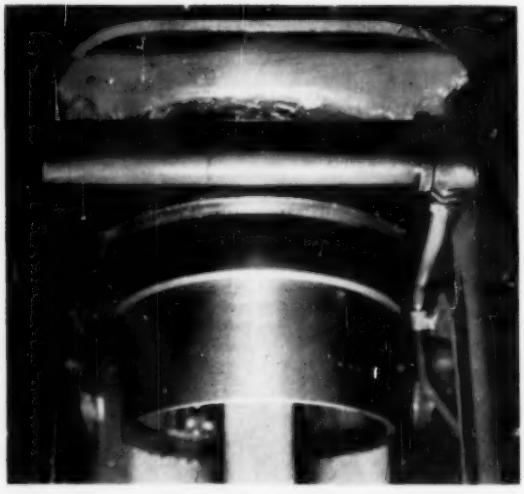

"As is" photo of piston skirt and interior of crankcase. No wiping or cleaning was done before photographing or at any time during 23,232 hours engine has been in service. STANODIESEL Oil M is the lubricant.

When a new 720 H.P. Superior engine was put in service at Milford, Iowa in 1949, the plant management knew what oil they were going to use—STANODIESEL Oil M. Their choice was based on previous experience with Standard diesel oils in other engines.

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